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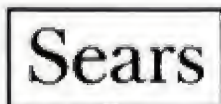
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On the cover

The most deadly tornadoes often do their damage on the ground with multiple, segmented vortices, rather than the single whirling funnel usually associated with these devastating storms. On page 64 you'll learn what scientists now know about tornado behavior.

—PM painting by Ed Valigursky

Popular Mechanics®

AUGUST 1980

CONTENTS

VOLUME 154 NUMBER 2

INTERNATIONAL EDITIONS: CARIBBEAN, ITALY, MEXICO, SOUTHERN HEMISPHERE

Special features:

Rating the 4wd mini pickups

Some upstarts, some surprises in PM's evaluation of four exciting new vehicles.

61

Woodworking aids you can build

PM offers designs for a tabletop lathe, lathe accessories, router depth gauge and molding cutter organizer. Begins on ...

98

How one wood stove heats a whole house

An architect combines the traditional Scandinavian methods with modern design for an innovative dwelling that pays energy dividends.

86

Robot plans and kits

The big new rage for the soldering-iron set—machines that "think" before they act.

16

Five great outdoor projects for summer

Complete plans begin with a terrific A-frame tree house.

92

Scandinavian-influence designs for three planters and a portable wine rack.

88

Automobiles and bikes

- 22** Imports and Motorsports
- 26** Detroit Listening Post
- 37** Firsthand Report:
Driving Audi 4000 and 5000 Turbo
- 39** Saturday Mechanic:
Tuning your suspension for performance and economy
- 49** The PM Garage
- 56** Car Clinic
- 61** Four new mini pickups show their off-road muscle
- 78** PM Owners Report:
Pontiac Bonneville
- 82** PM Owners Report:
Lincoln Mark VI

Home and yard

- 46** Homeowners' Clinic
- 52** Appliance Clinic
- 86** A home designed to be heated by one stove
- 95** Put a potting bench in a spare corner
- 96** Build PM's modular barn
- 114** Use hardwood scraps for low-cost barbecuing
- 130** Barbecue in a "well"

Electronics, radio and TV

- 13** PM Electronics Monitor
- 16** Robots you can build today
- 80** New computers can talk, control your house and sing

Photography

- 54** Photo hints
- 84** Cameras for the deep

Shop and crafts

- 32, 51, 122** Hints from readers
- 36** Toy shooter from the past
- 53** PM Workbench
- 88** Weekend workshop:
4 projects with Scandinavian flair
- 92** Build this treetop hideaway for your youngsters
- 98** PM's tabletop lathe:
A great tool for miniature makers
- 100** Workshop Minicourse:
Bench plane, part 2
- 109** 5 handy projects for your workshop
- 134** New Now for home and shop

Boating and outdoors

- 14** All Outdoors
- 74** Compact camp-cruising by kayak
- 76** New outdoor gear:
Lighter and stronger than ever

Science and engineering

- 50** Science Worldwide
- 64** How tornado labs tame giant twisters
- 70** Terror on wheels—by design

Every month

- 6** Letters
- 8** Notes from the Editor
- 33** PM Briefs
- 68, 134** It's New Now

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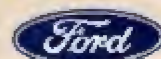
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LETTERS TO THE EDITOR

Another roadside attraction

The May *PM Briefs* ("A \$40 Mailbox That Does the Job," page 40) featured an 80-pound, high-security mailbox. This block of concrete set on a four-foot-high post could become a highly dangerous obstacle if hit by an automobile at high speed. Such an impact could result in 80 pounds of concrete coming through the windshield.

MARVIN G. GIESEKE
MARSHALL, MINN.

Bigger screen, same programs

In the February issue you ran a story on projection TV kits (*Build a Giant-Screen TV—From Kit or Scratch*, page 107). I went out and bought a lens and screen from Televue Optics of Spring Valley, N.Y., and I must say it is better than anything I have seen commercially available to date. I had been skeptical, since the components were purchased sight unseen, with end result completely unknown.

The only modifications I made were choice of set and the addition of a switch.

I used a 13-inch set and then put in a switch that returns the set to normal viewing when the projection system is not in use. I would say your cost estimate was correct; I had to buy the TV, so the entire cost was under \$700.

However, based on the end result, it's a bargain.

PAUL C. MULSON
TROY, N.Y.

Keep your eye on the ball

I read with interest *How Pros Take Those 'Impossible' Photos* (page 120, Apr. '80). Those of us working pros who do not have the budgets or sophisticated equipment have to be clever.

The simplest way to shoot a tennis ball on a racket is to attach it to the racket with a hollow wall fastener and a large washer.

If you should do that, of course,



"Impossible" photos: Poor man's way to make sure the ball is always on the racket.

the pretty model in the ad for the condo or hotel can hit the ball in every shot, even if she's never been on a tennis court.

HARVEY J. KELMAN
TAMPA, FLA.

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A&C GRENADIERS—THE TASTE LEADER

Car care queries

In your May issue on page 139 (*Car Care Guide 1980*) there is a picture of a 1980 Aston Martin Volante. I've never seen or heard of this one and it looks like a real beauty. Where have I been? Would you know who makes it, how much it costs and if there's a dealer in my area? I hope you can help me.

JAMES C. GONYEA
HOOKSETT, N.H.

We don't know if there's a dealer in your area, but you can find out by writing to Aston Martin Lagonda Inc., 14 Weyman Ave., New Rochelle, N.Y. 10805.

I agree with your statements in the May issue that car care pays off (*A Cared-For Car Is Money in the Bank!* page 142). However, the author of the captions on pages 142-143 needs to brush up on his car identifications. The Chevelle on page 142 is a '66, not a '62. The Olds 442 is a '68, not a '70. The red Chevelle SS on page 143 is a '70, not a '66. I like your magazine, but please make us car freaks and perfectionists happy.

DAVID J. DEGARCIA
ST. LOUIS

You're right, David. We blew it on that one. A local mechanic friend of ours who owns the '70 SS will never let us live it down.

Heartening news

How We'll Build a Working Human Heart (page 76, June '80) was fascinating: I was especially interested in the use of the Hall-effect device to regulate pumping.

The series action of the two pumps in the organ requires close regulation so that the stronger one, the left ventricle, does not outpump the other. Otherwise, death would occur within minutes. Apparently, the Hall-effect sensor accomplishes this regulation in the Hershey heart by pumping only when the chamber is filled and varying the frequency to adjust for volume.

Because the biological heart regulates both the frequency and the volume of each stroke, I wonder if sufficient runaway protection can be provided with an artificial heart.

ED TAYLOR
BREVARD, N.C.

The Hall-effect switch controls the frequency of pumping action in the

Hershey heart. But a second sensor, monitoring pressure in the body's main artery, controls current to the heart-pump motor. If pressure is too high in the artery, motor current is cut back. That, in turn, reduces the volume of blood pumped with each beat.

These feedback systems should prevent the left ventricle from out-pumping the right, the Hershey researchers tell us.

Addendum

We've received many queries about the brush-on plastic tape mentioned in *Photo Hints* in the April issue ("Light-Leak Repairs," page 70).

The plastic tape is currently available in many electronics supply stores or directly from the manufacturer: Tech Spray Inc., Box 949, Amarillo, Tex. 79105.

Correction

In *Build the Basement Water Alarm* (page 56, July '80), we mentioned that a complete kit of parts is available, but we neglected to include the address and price. The alarm costs \$14.95 (kit) and \$19.95 (assembled) from Circuit Craft, 10 Idell Rd., Valley Stream, N.Y. 11580.



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NOTES FROM THE EDITOR

John A. Sallitter

Back in the days when we were certain of almost everything, we knew that tornadoes were exclusive to the middle states, just as earthquakes confined themselves to the West Coast and hurricanes to the East Coast. But tornadoes, we've observed, have not had the decency to stay put and have been lambasting almost every section of the country. It seems that their fury and their frequency have been increasing each year. Along about this time of the summer, you'll find some comfort in knowing about the lifesaving precautions listed in our tornado article that starts on page 64. There are lots of fascinating new facts about twisters, too, that authors Franklynn Peterson and Judi R. Kesselman have discovered and reported for PM. . . . **One of our favorite correspondents over the past 15 years** has been a do-it-yourselfer in



The king and I.

Switzerland. Even though he spends his spare time working on cars, he's not your average car buff. He's King Michael of Rumania, who was forced into leaving his throne in 1947. He's an active metal-worker and woodworker, and his real passion is maintaining a World War II Jeep. He dropped by our office recently to delve into the mechanics of producing a magazine. As you'll note in the photo at left, we were in the midst of producing the issue you have in your hands, but King Michael was even more interested in tracking down the source for a new wrench for his car. . . .

There's often a reassuring "down home" result to the di-

rection—I should say directions—of today's technology. As you'll see in this issue, you could be right in the forefront of things, performing all sorts of wondrous electronic magic with a sophisticated personal computer (page 80) while living in a contemporary home that's heated by a single wood-burning stove. (page 86). At some point, you might even consider building a robot to go out and chop the wood. For practice, try one of our seven do-it-yourself robots (page 16) that aren't quite smart enough for the job yet, but will make fine household pets until a lumberjack version comes along.

Okay, it's tough to photograph yourself on a roller coaster. Robin Nelson tried it, mainly, we think, to prove his iron nerve. Even though this picture isn't great, he *did* get the story (page 70). But what struck us about the photo is the apprehension on riders' faces. Hey, folks, it's supposed to be fun!



PM Just keep saying: "I'm having fun, I'm having fun."

New from NRI! 25" color TV that DIAGONAL tunes by computer, programs an entire evening's entertainment.



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NRI is the only home study school to give you the actual "hands-on" training you need to handle servicing problems on tomorrow's electronic equipment. Because only NRI includes this designed-for-learning, 25" diagonal color TV with electronic tuning, built-in digital clock, and computer programmer as part of your training. With this advanced feature, you can pre-program an entire evening's entertainment...even key lock it in to control children's viewing.

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NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016



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Volkswagen's new Pickup: It's built like a truck, but drives like something else.

Where is it written that a truck has to drive like a truck? Certainly not on that brand new Volkswagen Pickup Truck. When it comes to going, a VW Pickup can pick 'em up and lay 'em down with the best of 'em. Under its aerodynamic hood is a very dynamic engine. A fuel-injected, overhead cam powerhouse that can outaccelerate even an MGB.

And should you ever catch up to a VW Pickup, you'll never catch it wallowing through corners like other trucks. Its front-wheel drive and front-mounted transverse engine help keep it moving nimbly. Even when the road throws it a curve. The steering is precise and quick because it's Volkswagen's rack-and-pinion system. What's equally impressive is how good a pickup a VW Pickup is. It's the only truck in its class with a fully unitized body and double-wall

bed construction for extra strength. And its heavy-duty suspension takes the tension out of hauling over 1100 pounds of stuff. So a truck is a truck is a truck, eh? Well, not if it's a Volkswagen Pickup Truck. Then it's something else.

**VOLKSWAGEN
DOES IT
AGAIN**



PM ELECTRONICS MONITOR

Sony's audiodisc

Sony Corp. has interested one other company, Willi Studer of Switzerland, in supporting its own format of audiodisc as a standard one. The audiodisc is the new digital technology that may make obsolete present-day recording methods.

The fledgling audiodisc industry has seen almost as much confusion as the videodisc market, what with competing technologies. Each company's approach to an audiodisc has tended to mirror the company's form of technology developed for videodisc. Both are digital technologies; both offer quantum leaps of quality over what is now available.

It now seems, however, that the audiodisc market may stabilize first as far as technology. If so, this may result in a number of benefits to all audiophiles. With a standard system, immense amounts of software (recorded music) should become quickly available.

There is no doubt that videodiscs and audiodiscs will someday totally change the face of home entertainment. The only thing standing in the way, so far, is the lack of standardization consumers and secondary suppliers need to have.

More on word processing

When PM designed a personal computer word processor (page 78, July '80), we mentioned that the Radio Shack computer (TRS-80) was also capable of such tasks but, at the time, not capable of lower case (small) letters. Well, Radio Shack now makes a lower-case modification for the TRS-80 for under \$100.

Even nicer is its new word-processing program "Scripsit," which lets you compose any kind of copy. The program, as the others we reviewed, is a character-based processor. Changes to text can be made easily and neatly.

Super sound from your old TV

In May we had an article on new television sets that feature close-to-high-fidelity sound (*Now: TV With True High-Fidelity Sound*, page 76). One of the featured lines was the Supersound series from Sylvania.

Sylvania is now making the Supersound components available separately so you can add high-fidelity sound to your existing television. The bookshelf-size unit features an 8-watt amplifier and two-way speaker system.



Cleaning your television tuner

If your TV has a mechanical tuner (channel changer), sooner or later it can develop a problem. You may have to rock the channel selector between channels a few times before reception on one channel manages to come in static-free.

Possibly you won't be able to get decent reception at all—but you'll notice that if you lightly strike the tuner knob, the static momentarily clears up.

If this is happening to your set, save yourself the expensive cost of an unneeded service call. It's likely that your tuner just needs cleaning. Most electronic stores (Radio Shack is a

good bet) sell TV-tuner cleaner. The aerosol can comes with a long tube that fits onto the nozzle.

Simply turn off the set (better, unplug the power cord) and remove your TV's tuner knob from the shaft. You'll see the shaft disappears into an enclosed box that contains the tuning mechanism. The box should have a few small openings. Direct the spray into the tuner, through the openings. Turn the tuner through all channels clockwise. Spray. Turn counterclockwise.

This simple procedure just might clear up your TV-reception blues.

The system plugs into Sylvania sets that have audio output jacks. Other brands of sets may need slight modifications.

Talk about pinball wizardry . . .

Pinball machines have always moved with the changing times to provide flipper connoisseurs electronic thrills and excitement. But Williams Electronics has announced a new pinball wrinkle—a talking machine that speaks such epicurean *bon mots* as: "Me got you," "You got me," and the pitiful "Gorgar hurt." The voice is produced by computer synthesis and is capable of 147 variations of 31 basic sounds. Gorgar now has a vocabulary of 21 phrases. Pinball machines have always been personable—now they're talkative.

Have your own war room

In 1941, the German battleship *Bismarck*, accompanied by the cruiser *Prinz Eugen*, stole into the North Atlantic. The hunt to sink the *Bismarck* was on, led by the ill-fated British battleship *Hood*.

The mission to destroy the *Bismarck* was one of the most complex

tasks in the annals of modern warfare. A new computer game, "Computer Bismarck," recreates all of the complicated maneuvering as it simulates that battle and captains the Germans against you.

The wealth of detail, from the display map of the North Atlantic to rules for refueling aircraft, is hardly short of fantastic. Only real war rooms such as those in the Pentagon have ever before been able to simulate a battle in this manner.

The game (or battle simulation) is available from Strategic Simulations (Box 5161, Stanford, Calif. 94305) in versions for the Apple and TRS-80 home computers. There is nothing else like it!

PM



ALL OUTDOORS

Rockets' red glare

As if in answer to PM's request last month for signal flares to meet the new Coast Guard requirements (*Pyrotechnics to Save Your Life*), Olin Corp. has announced six new kits.

The new regulation goes into effect in January 1981 for boats over 16 feet long during daylight hours, and for all boats of any size after dark on coastal and Great Lakes waters. States are likely to issue similar requirements for all inland waters, and now is none too soon to carry distress signals afloat.

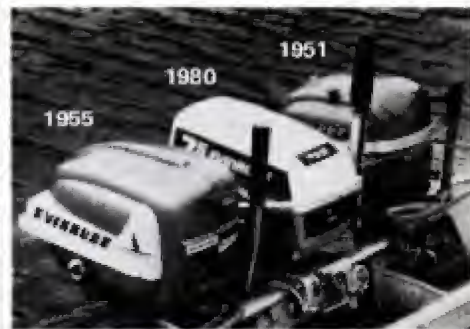
The kits from Olin's Signal Products Operation, a companion division to Olin's well-known Winches-Wester-Western Group, are bargain-priced from \$10 to \$95. For boatmen who are nervous about firing rockets or holding flares, there will even be a \$55 S.O.S. Day/Night Kit with an orange flag for day signaling and a high-intensity light that automatically blinks an S.O.S. to meet the requirements of the new law.

When you're in trouble, you want

to attract a rescuer's attention, alert him to a problem and then show him your location, Olin Signal Products director Carl Johnson points out. A meteor or parachute flare is probably the way to go for an alert, followed by a hand-held flare or smoke signal indicating location. Olin's \$20 alert/locate kit Model 12AL comes in a waterproof canister, has three 12-gauge meteor flares, a pistol launcher and three hand-held flares. It's good for three years, satisfying Coast Guard requirements.

How far have we come

"The good old days" were comparison-tested recently by Evinrude Motors, using 7½-hp motors from 1951, 1955 and 1980. Each was mounted on a 148-pound, 14-foot Alumacraft fishing boat rated for engines up to 25 hp. Evinrude manager Jim Riegler picked the '51 and '55 models, since many of them are still in use around the world. The results seem to indicate we've come a long way.



Comparison tests of two old 7½-hp motors and a new one show outboards are getting lighter, stronger and more fuel-efficient.

Speed trials showed the '51 motor could do 6.06 miles per hour, the '55 topped out at 12.33 and this year's model could plane with the same driver aboard at up to 17.4 mph. Meanwhile, at various speed levels, the new motor had 45 to 147 percent better fuel economy than the '51 mill and 15 to 166 percent better than the '55. When trolling, the new rig is 144 percent more economical than either of the older motors. Accelerations

MOTORCRAFT



HI, SLICK.
WHAT'S
NEW?

ME!

A TOTALLY NEW
MOTOR OIL, FORMULATED
TO MEET THE STRINGENT
REQUIREMENTS OF THE
ENGINES OF
THE '80s...

AND

OFFERING GREAT
PROTECTION TO THE ENGINES
OF OLDER CARS, TOO.

tion is 61 percent better for this year's 7½ than the '51, and 14 percent better than '55. The engineers attribute the big fuel savings to modern designs that are now smaller, lighter, faster and more efficient. It's a good case for rigs we can buy today.

Sailing standing

Surfboards that mount sails aren't new, but their boom in popularity is recent. The Windsurfer was one of the first, but now there are nearly a dozen different brands around and this summer almost every lake appears to have one or more silhouetted against the sun. Once again, it seems to be a trend—like those for compact cars, high gasoline prices, inflatable boats, scuba and cross-country skiing—that got the first big push in Europe.

Like other miniature sailboats, a wind-powered surfboard is not as easy to learn to sail as it looks, but experienced skippers have recorded speeds up to 20 miles an hour. Hoyle Schweitzer, who is credited with inventing the sport, wanted to simulate the sensation of surfing, but without waves, and his success is marked by the over 300,000 now in



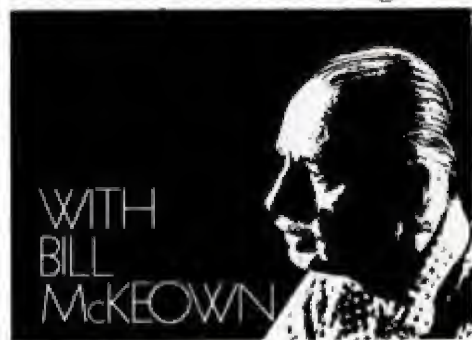
Newest boating boom calls for sailing on a surfboard. Over 300,000 are in use; the sport may become an Olympic event.

use. Premier American yachtsman, America's Cup skipper Bob Bavier, predicts Windsurfers may be in the 1984 Olympics. Meanwhile, they make a fine free-energy way to go boating with one or, more recently, twin sails and two sailors aboard.

On-the-go

Eastern boatmen should mark down Mystic (Conn.) Seaport's Classic Boat Rendezvous, Aug. 1, and plan a mid-month drive or cruise to New York's Thousand Islands. Collected at the Clayton, N.Y., Shipyard Museum are some of the finest antique yachts and oldest outboard motors, and on Aug. 16-17 the annual antique boat show and parade are held on the St. Lawrence River.

Westerners trying that ultimate drive to Alaska and back will be using *The Milepost* in a new 500-page edition with its mile-by-mile log. Now there is a companion book, *Rough Road to the North*, by Jim Christy, that records the romance of that road as well. Both are from Alaska Northwest Publishing. **FM**



MOTORCRAFT

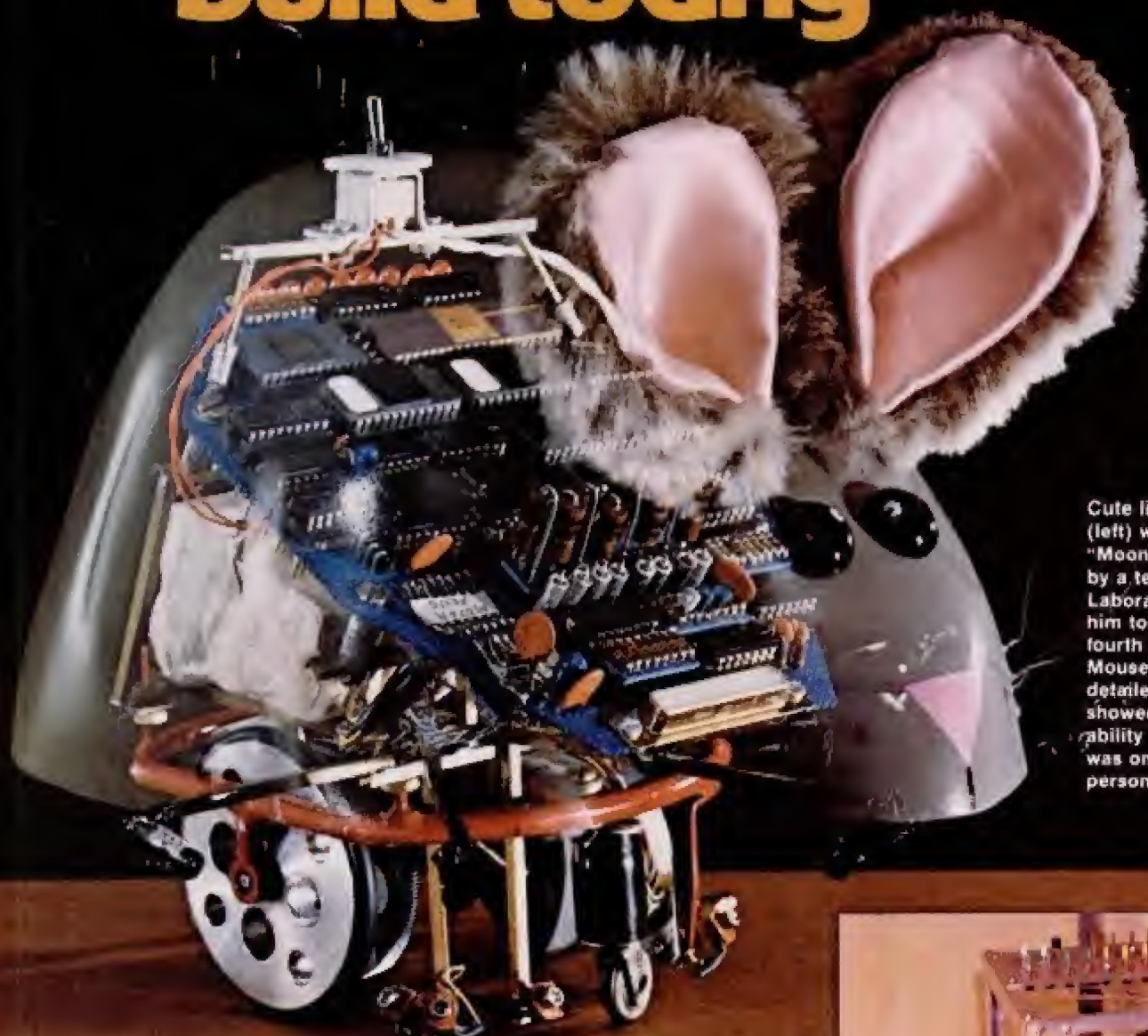
OH...THERE'S NOTHING LIKE AN OIL THAT RUNS ON AND ON.

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Robots you can build today



Cute little critter (left) was named the "Moonlight Special" by a team at Battelle Laboratories who put him together. He ran fourth in the Micro Mouse maze race as detailed in text but showed second-best ability to learn and was one of the more personable entries.



Terrapin Turtle (left) uses a home computer for a brain. A rolling artist, it drags a ballpoint pen on the floor. Nwt (above) rides on three wheels and is planned to have photosensitive "eyes."

Photo: Byte Magazine
Nwt: R. J. W. 1985/11/16

Robots have moved out of science fiction and into the home. Though neither Frankenstein monsters nor superhelpers, they're proving to make great pets!

by Bill Allen

You can now build a robot from plans and kits, or buy a complete miniature robot which interfaces with a home computer. But these designs don't ape *Star Wars*' "R2D2" or "C3PO" in form or function. They're small and must be kept to controlled environments (stairs are fatal).

There's not much useful about them, either. They're quite unable to perform anything like housework. For now, consider them amusing pets.

But everything starts somewhere and, enthusiasts predict, 1980 will begin the "home robot boom." Already, there may be more privately owned robots in the United States than industrial counterparts.

Telltale turtle

Surprisingly few similarities exist among seven available robots. Terapin Inc.'s Turtle is simplest, smallest and the only one "ready to plug in" for average home computerists.

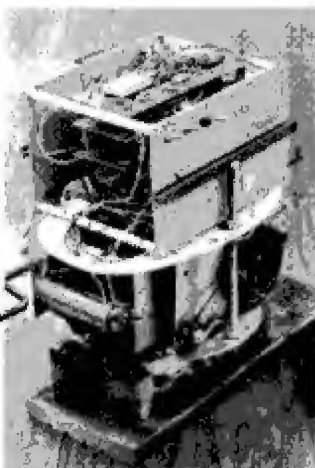
Plug in you must; there's no room for an onboard computer. Five inches high and carrying a 7-inch-wide, see-through, surrounding plastic dome, it roams on two independently driven 4-inch wheels and two fixed knobs.

Turtle's belly holds a vertical pen which lowers to paper on command to tell its view of a room it has explored, or to illustrate answers to mathematical problems.

Turtle costs \$400 in kit form, requiring simple tools and a few hours, or comes ready-built for \$600—both

(Please turn to page 124)

OF MICE AND ROBOTS —IN COMPETITION



There are intelligent and dumb "micro-mice," but the difference isn't in their ability to be house-trained. Any droppings would cause suspicion (unless bearing color-banded resistance codes) because micro-mice are electromechanical creatures.

Why make a mouse? Well, perchance to win \$1000 as in last year's Amazing Micro-Mouse maze contest, sponsored by the Institute of Electrical and Electronics Engineers' *Spectrum* magazine.

From some 6000 applications, perhaps several dozen entries were built, but only 15 showed and six finished at the finals in New York City (four trials were held elsewhere). They were mega-mice relative to their furry fellows, but quite small as robots go.

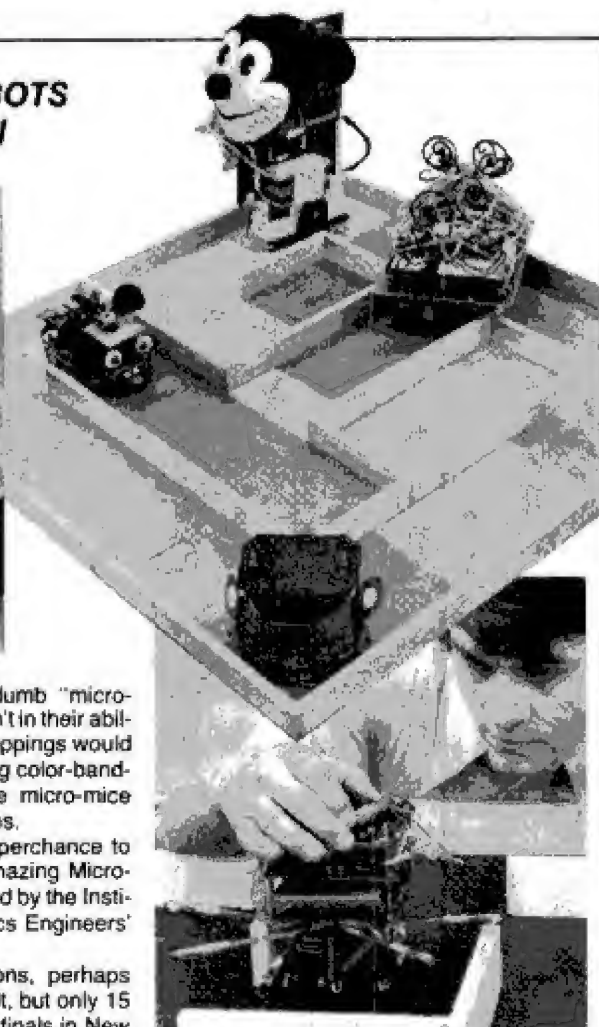
Rules allowed three timed runs through (no jumps over) a level maze up to 20 feet square with 6½-inch-wide corridors and 2-inch-high walls arranged in Ls, Ts, Us, straightaways and dead ends, but no four-way intersections. Configuration was secret until entrants turned their charges over to officials.

Bumping walls over and over

Dumb robot rodents simply bumped repeatedly into either left or right walls without being able to remember the experience for improving successive runs. However, "Harvey Wallbanger," of this type, did the third best time—39.96 seconds.

Another partition hugger, "Brutus," didn't enter. Just as well; it smashed down a test

Grivet series of interchangeable parts allows for different configurations to be built. Manipulators now are being redesigned by the manufacturer.



The Amazing Micro-Mouse contest drew 6000 applications, but only 15 actual entrants. Only six of those micro-mice finished trials. The robotic mice had to find—map—their way through a complex maze without climbing over walls.

maze's walls. "Unfortunately, there's no way of controlling it," lamented one of its builders.

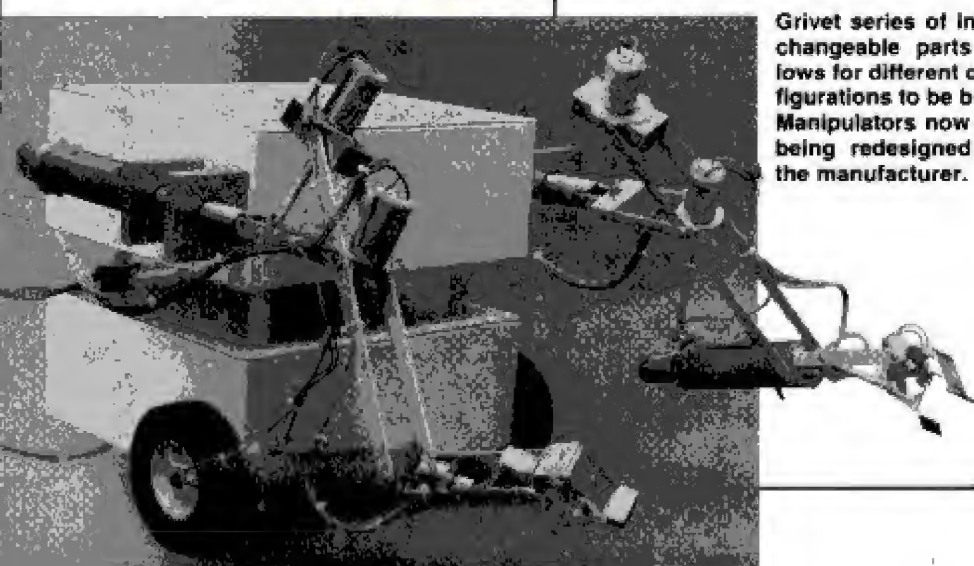
Some designs detected partitions by contact, such as "Kimbot." It also had an entire KIM-1 computer board (turned edge-up, there being no height limit), but didn't finish.

Three employees of Battelle Institute, on spare time, created "Moonlight Special" and "Moonlight Express," aided by preliminary computer simulation. Both incorporated the Z-80A MPU and navigational exacting "stepping motors." They put in successively improved times from 66.98 to 50.38 seconds and 100.88 to 31.16 seconds (second best time), respectively, thus winning "smartest mouse" award.

But the overall victorious varmint was the Battelle team's "Moonlight Flash," a hybrid. It followed the right-hand wall, but also had broken beam light sensors, 8748 MPU and limited memory, and was built for speed—squeaking in at 29.78 seconds.

Dr. Claude Shannon was present for the finals, with his 1950s version of a mechanical mouse maze. He built the relay logic device while at Bell Labs to help work out mathematical theory for optimizing telephone-call switching.

Today's toys frequently test tomorrow's technology.—B.A.



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HOME ENTERTAINMENT ELECTRONICS

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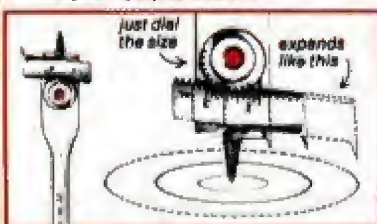


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IMPORTS & MOTORSPORTS

New French sedan



Talbot C9 is
on 109-inch
wheelbase.

Is it just another pretty face, or is this cleanly styled, lightweight, economical, four-door family sedan going to be heavyweight competition in the European marketplace? Here, a car like the Talbot C9 would be pounced on by car shoppers who are finding that designs from Europe and Japan offer cars for the '80s right now. But in Europe, Talbot is up against a goodly number of established and formidable competitors. The Granada and Renault 20 are two of the tough ones.

Interestingly, the car was developed by Chrysler as Project C9—before the company liquidated its Chrysler Europe operation. When the Peugeot empire took over Chrysler-Simca, it changed the marque to Talbot. The C9 will be the flagship of the Talbot line when it's officially named the Arena and formally introduced at the Paris Auto Show next month.

Hot under the hood

It takes a while before we see the cars developed by Japanese automakers. The home market always gets first crack at the latest offerings. And the best-selling set of wheels on the Ginza right now, in the 1600- to 2000-cc class, is the new Bluebird (that's known as a Datsun 810 model on Main Street). But if the Japanese enthusiast really wants to run a hot Bluebird, it's got to be the turbocharged version. The 1.8-liter



Datsun turbo Four displaces 1.8 liters.

Four with turbo, cranked to 6000 rpm, is good for 135 horses. We're likely to get a crack at it when production numbers (only 1000 turbos are built each month) get high enough to allow export.

Datsun also turbocharges its big Cedric and Gloria series (where do they get those names!). The powerplant is a two-liter Six. These somewhat frumpy luxury sedans are strictly for the home market, so there's no chance we'll find a Cedric in a Datsun showroom.

Gypsy cab

If you think you "can't take it with you," try the '80 Vanagon camper. The kitchen sink, double beds, stove, city water and electricity hookups all go along for the ride. And, with



VW Vanagon camper gets PM sleep test.

20-mpg economy, riding the range is easy for even campers with nothing more than a gypsy's gas money. Now that we've had a chance to really test the camper—by sleeping in it—we're even more impressed with this mini-motorhome than we were when we first drove it. (For the ride-test evaluation of the Vanagon, see [Driving the 1980 VWs, page 98, Feb. '80.](#))

If there are just two of you, use the master bedroom downstairs. But it's more convenient, and fun, to use the duplex arrangement and sack out upstairs in the tent-like pop-up top, leaving more open space

below. With two or three kids, however, you *have* to sleep below: Just try 'n' tell 'em the tent isn't their turf! The basic Vanagon is now \$10,000 and the camper several thousand more, so getting on the road isn't cheap. But, once you're heading for the hills, the Vanagon is motor-camper heaven.

Whatchamacallit with wheels

"Let's go riding in the car-car..." go the words of the folk song. The putt-putts and other sound effects you'll have to provide yourself (and you're pretty good if you can do them better than Pete Seeger). A car, that's what the thing with wheels is today. Just... a car. Before the turn of the century, people didn't know what to call it. Horseless carriage was a cop-out. Auto car? Motor car? At first, *automobile* was rejected here because it was a French word.

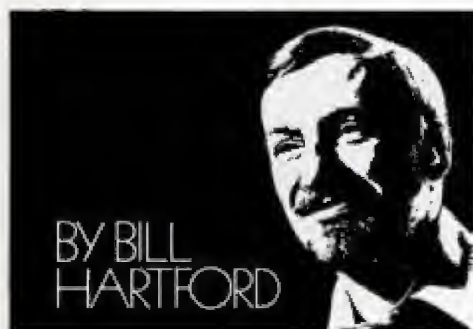
Recently, a group of craftsmen in England discovered a market for



Modern drive train is under classic van.

specialty vehicles resembling the whatchamacallits of the early 1900s. They started the Albany Motor Carriage Co. Ltd. That tells you what name for "car" they prefer. The classics are built with modern drive trains. The establishment is located at Groveley Rd., Christchurch, Dorset, England. All its motor carriages are sold complete with tyres, headlamps and mudguards—whatever they are.

PM



Photomicrographs of the three major types of fungus that cause athlete's foot.

1. *T. mentagrophytes*

2. *E. floccosum*



3. *T. rubrum*

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DETROIT LISTENING POST

GM J-cars

Spy photos of General Motors' anxiously awaited J-car front-wheel-drive subcompacts reveal that the Pontiac version sports a nose much like the 1977-'78 Firebird, split grille openings with quad rectangular lights and V-shaped center section. The Chevy version has a simple, low, horizontal mouth between big, twin, rectangular headlamps. Large windows with low "beltlines" give both cars a very European look.

The J-designated cars are now set to replace Chevy's Monza and Pontiac's Sunbird next May, but Olds and Buick won't get their versions until fall or even the following spring. The reason for this delay is to allow added development time for these more expensive versions so the divisional differences will be obvious, and



Chevrolet's new J-car sports a low grille as well as large rectangular headlamps.

strong enough to justify their higher prices. The now-discontinued Olds Starfire and Buick Skyhawk were little more than warmed-over Monzas, which hurt their sales significantly.

There's even talk at GM of giving the Cadillac Div. a version of the economical J-car at some future time.

AMC/Renault future plans

Both American Motors and its technically aggressive French partner, Renault, have been very tight-lipped about future product plans. But we recently visited Renault in France, drove several of its current products and talked with several of its key engineers and executives. We've joined some known facts with educated guesses to come up with a likely scenario of what's ahead.

We'll soon see the very nice front-drive R-18 four-door sedan and five-door wagon making its debut. By September, the excellent R-18-based Fuego sport coupe should arrive, ready to do battle with the likes of Toyota's Celica, Datsun's 200-SX and the rest. A year or so from now, there should be a peppy and econom-

ical diesel engine for the 18, and soon after that may come a turbo-charged diesel and perhaps a turbo gas engine, as well.

Meanwhile, the AMC Spirit-based four-wheel-drive car (code-named "Eaglet") is set to debut in the fall, and the larger Concord/Eagle series should be due for a redesign, becoming slightly smaller and lighter.

Two-seaters coming

Why are GM, Ford and Chrysler all working feverishly to develop new two-seaters when (except Chevy's Corvette) they've ignored this car market for so many years? Certainly the quest for youthful, exciting image cars and the continued success of imported sports cars are factors. But most important is the rapid proliferation of fairly sophisticated econocar machinery that will make good platforms for affordable sports and sporty models.

The original two-seat T-Birds and Corvettes used standard-car components of the time—not very practical or satisfactory. But consider the possibilities of GM X- or J-cars, Ford Escort/Lynx and Chrysler Reliant/Aries-based sportsters. All are front-drive, light, agile and economical. Plop a still lighter and sexier sports-car body on any of these, and you should have an instant winner at a reasonable price. Stir in turbo-charging and some other performance goodies and you have potential Porsche beaters.

All three companies are looking hard at this possibility, and the first (probably the much-rumored GM car being developed by Pontiac Div.) could be available as early as the '83 model year. Tiny, two-seat commuter cars and minivans and trucks are also likely spinoffs from these efficient, new front-drive platforms in the next several years.

Chrysler gears up

Anxious to build interest in its upcoming products, Chrysler treated reporters to an unprecedented tour of its Detroit Clairpointe preproduction plant, where "pilot-line" '81 compact K-cars and luxury Imperials were already being assembled. This small plant (about 200,000 sq. ft. with a permanent staff of only 150) exists for the sole purpose of building preproduction cars to try out tooling and assembly fits and techniques, and to train assembly



The 1981 Plymouth Reliant is being tested for the final-tooling and assembly fits.

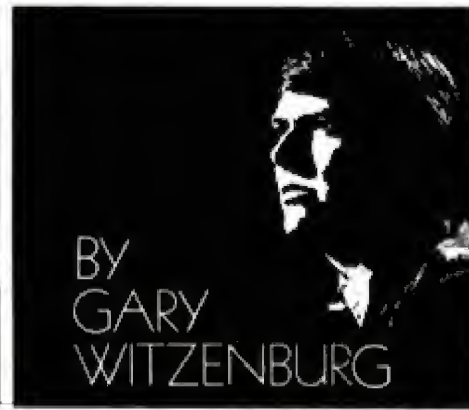


Station-wagon version of the Reliant is being fitted with preproduction doors.

foremen and supervisors for volume production.

Prototype or "pre-pilot" assembly of each new model (using prototype parts, often handmade) begins some 10 months before actual volume production. The resulting cars are used for engineering testing and early photography. Pilot production then commences four months or more before the main assembly plants swing into gear, using parts from actual production tooling. This gives ample time to correct any manufacturing problems well before full-scale start-up.

The K-car and Imperial pilot programs will be 18 and 19 weeks, respectively—Chrysler's longest ever. This is part of what the company calls "the most extensive quality assurance program in the industry." The Imperial will become the new Chrysler flagship, and the fwd K-cars (Plymouth Reliant and Dodge Aries) replace the compact Volare and Aspen. **PM**



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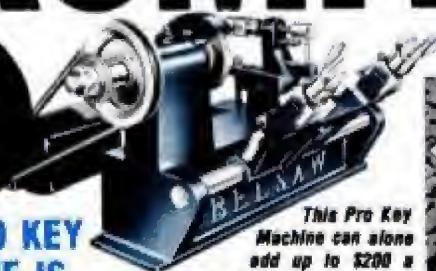
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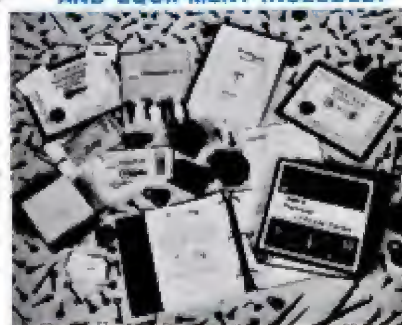
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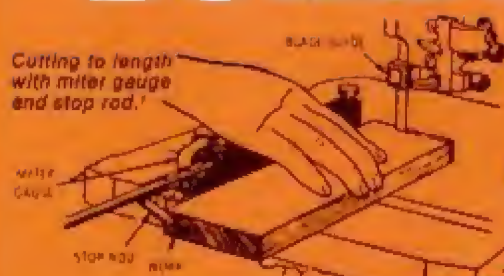
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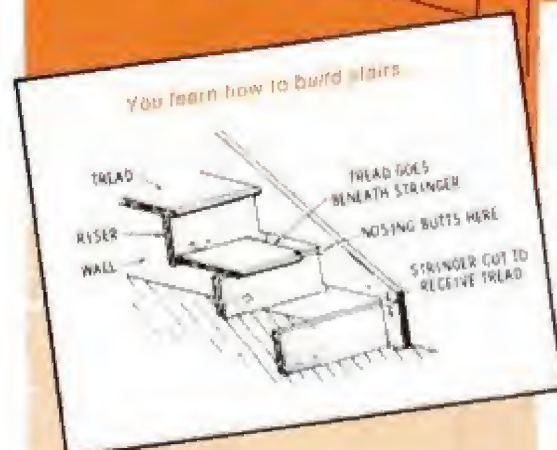


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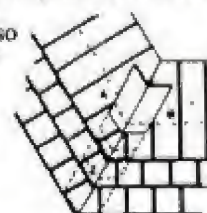
- You get a complete how-to book on woods and woodworking tools, how to do all kinds of joinery and cabinetmaking joints, how to do kitchen cabinet construction... and more.
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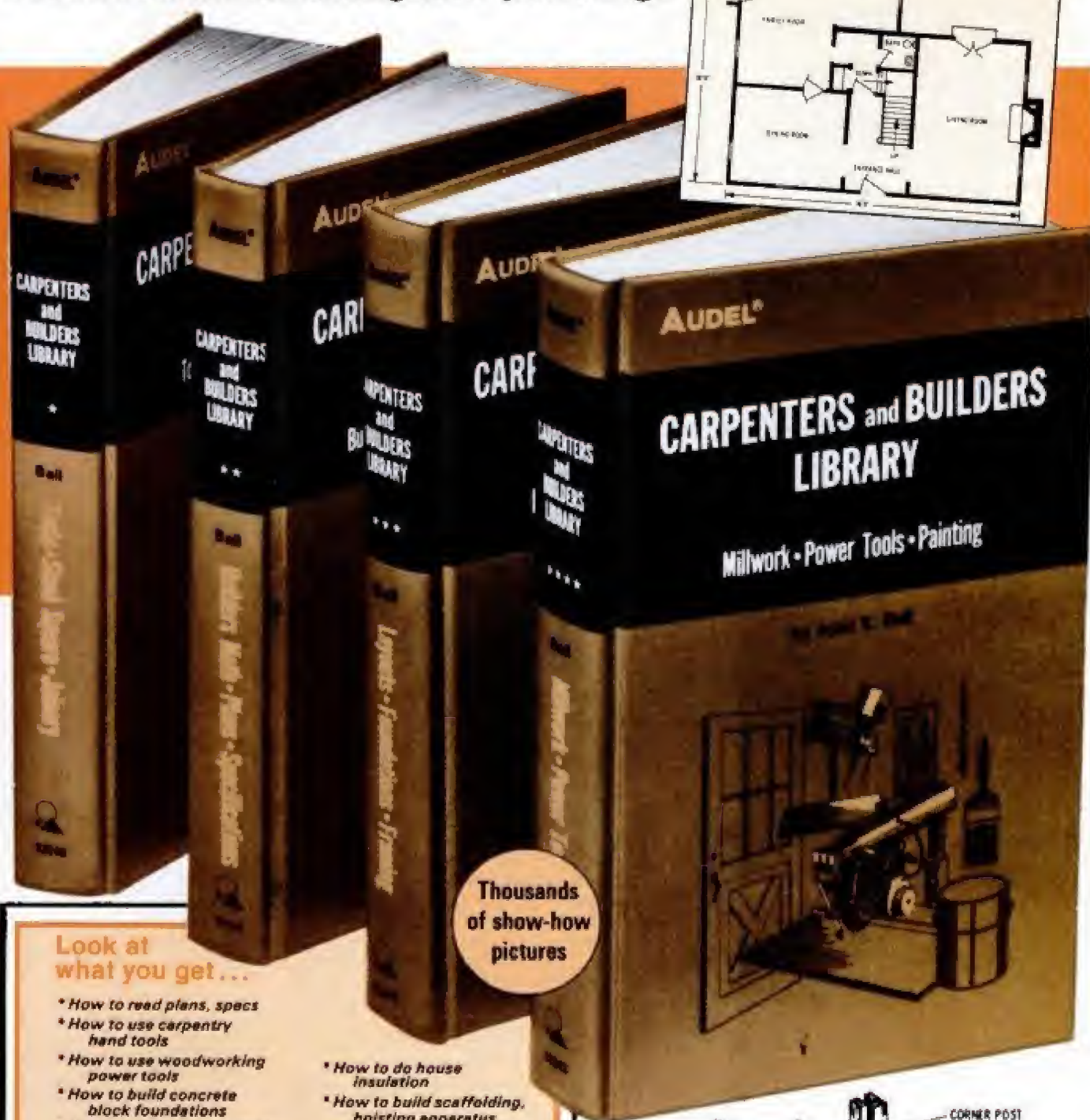
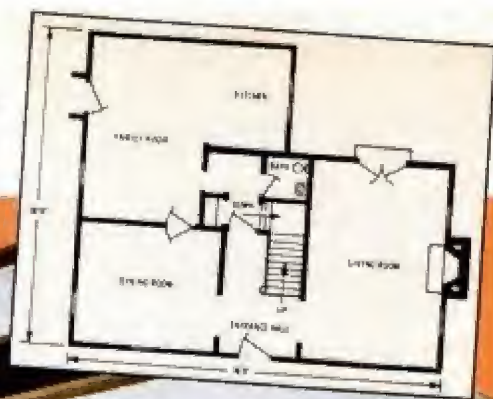
If doors need fixing or fitting, you can find out how to do it from these books. If you want to lay new flooring, you can just turn to these books to find out how to do a first-rate job with wood-tile, linoleum, asphalt, rubber or ceramic tiles. If you want to build a fireplace, you'll find out exactly how from these books...

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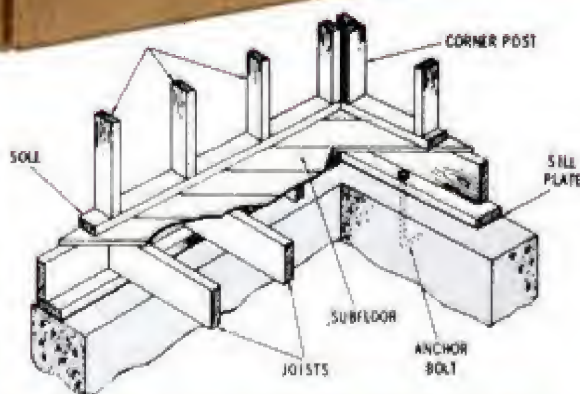


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use mine the most.) Use it on a plane or a commuter train. Keep it by your bed. Find out how useful it is—for jotting down ideas . . . summarizing meetings . . . keeping track of expenses. Then, if you want, just



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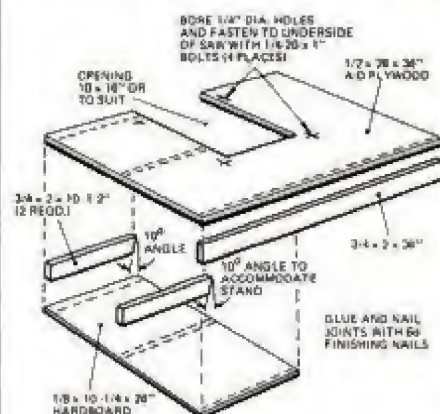
HINTS FROM READERS

Saw-table addition



Shelf provides handy blade storage.

This addition to a saw table gives you a deck for rules and pusher sticks, as well as a convenient shelf to store extra saw blades. The table shown is designed for a 10-in. Craftsman table saw. Change dimensions to suit your saw if necessary.—George J. Danko



Retreading rubber tips



If a rubber crutch or furniture-leg tip has worn smooth, but has enough bottom thickness left, you can give it a new tread. Use a triangular file to make several shallow grooves in a diamond pattern.—Walter E. Burton



Where's the putting green?

Sometimes you get the feeling that failed brain surgeons, as well as their patients, often retire into the business of thinking up golf aids. This might be yet another example, except that it was developed in Aberdeen, Scotland, the spiritual as well as literal home of the game.

It works this way: With no more than 12 feet of clear space in which to work on your swing, you fill this black rubber box with sand, flail away at it with a specially designed club, measure the 10- to 12-foot blast and use a booklet of tables supplied with the apparatus to tell you how far the box would have gone if it were an actual...well, you get the idea. A rubber ball, which serves as the hitting area, is molded to the rectangular box. When hit, the contraption does actually exhibit golf-ball behavior, including hooks and slices.

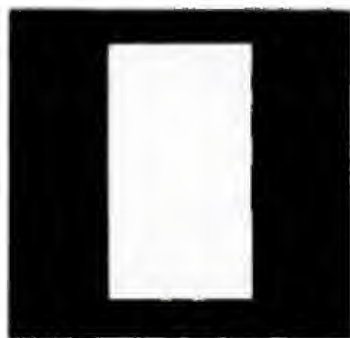
Without a paddle

If you were wondering what new outdoor gimmick was going to help you unwind and keep your mind off the rat race on weekends this summer—now you know. Thanks to the manufacturers of Wonder Wheel, you can experience the wonderful sensation of going nowhere fast while making actual progress over the water—or snow, or sand dunes. They tell us that it's made of rubberized nylon fabric, like inflatable rafts, and weighs 47 pounds deflated for carrying or storage. Rotating handles located on the 94-inch wheel's axis steady the novice rider as he masters the coolie-like art of Wonder Wheeling while, in the words of its marketer, "improving muscle tone and stamina."

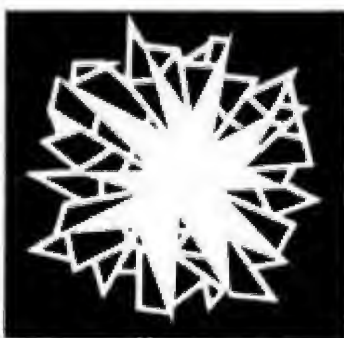


PM's Whatsit

From time to time, a group known as the International Organization for Standardization makes recommendations for the adoption of universal symbols to be used on signs throughout the world. Recently, our National Bureau of Standards tested some fire-safety symbols proposed by the ISO on volunteers to determine how well or poorly they would serve Americans in an emergency situation. The results were not always good and certain revisions were recommended to the international group. Meanwhile, can you understand what these four signs are trying to tell you? Turn the page for the answers.



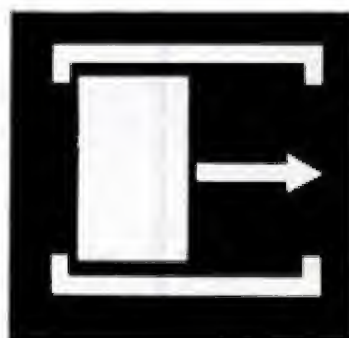
1



2



3



4

Whatsit revealed

1. Emergency exit. 2. Break glass to obtain access. 3. Blind alley. 4. Door slides right to open.



It's sod and they're happy

Prospects for energy savings in an underground house (page 114, May 1980) may be interesting to people who have yet to build their homes, but some of us are already comfortably ensconced. Well, so were Ken and JoAnn Cowan in Encino, Calif., but that didn't stop them from putting on a sod roof last July as an experiment. The excellent insulating qualities of the new roof became apparent over the summer, when the Cowans' electrical bill dropped by more than half.

As far as any drawbacks go, you're looking at the biggest—and it happens every two weeks,

Meanwhile back in the kitchen

Lockheed had troubles in its Missiles & Space Div. plant in Sunnyvale, Calif. The solvents normally used to clean complex electronic assemblies were found harmful to new materials used in the circuit boards. A special in-house research group was formed and put on the problem, and in the ensuing weeks searched high and low for some kind of industrial process that would solve it.

"Aha," the research group said one day, "detergent and water will do the trick."

Which is why, to this day, you'll find the Lockheed Missiles & Space people putting aerospace circuit boards into a regular dishwasher and throwing in a little commercial detergent.



Reach out and put the touch on someone



It's something you never think about, but—hey—prison inmates like to keep in touch by long distance too. Not to their complete surprise, however, some prisons have had problems with fraudulent billings. And although it pains them to report it, they tell us that in some cases inmates have had the audacity to bill long distance calls to third-party numbers that turned out to be those of high prison officials—including the warden. The coinless freewheeling phone shown in use here at the Dallas County Jail eliminates billing problems since it has been adjusted to accept only collect calls. And rather than requiring someone to escort the caller to a phone booth, the phone comes right to his cell. And remember, it's the next best thing to being there.

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Kings & 100's

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Kings: 8 mg "tar," 0.6 mg nicotine—100's Reg: 10 mg "tar," 0.7 mg nicotine—
100's Men: 11 mg "tar," 0.8 mg nicotine av. per cigarette, FTC Report Dec:79

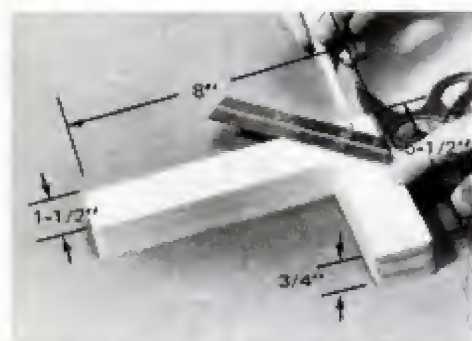
Toy shooter from the past

This toy shooter that I made for my grandson reminds me of the ones I made as a boy (from the corner of an orange crate). Later, my kids made several shooters at a time and had great fun holding contests.

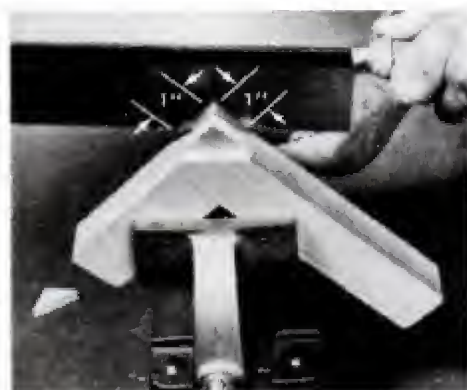
This shooter is cut from a 5½×8-in. piece of nominal 1-in. stock. Balloons make colorful, bobbing targets. —Stan Gilbert



"Bullets" of 1-in. cardboard squares work well. To fire a bullet, slide it under one side of the stretched rubber band. Then roll the rubber band off the trigger with your thumb. Remember, never point a loaded shooter at anyone; even cardboard can damage an eye.



Notch the trigger from both sides of the shooter. First measure 1 in. at the right angle of the shooter in both directions; join these points by a pencil line.



Make ¼-in.-deep cuts on the pencil lines; then make corner cuts to remove waste.



Fasten a heavy-duty rubber band to the muzzle of shooter with an insulated staple.



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Driving the Audi 4000 and 5000 Turbo



The turbocharger adds 30 hp and sparkling performance to Audi 5000's 2144-cc engine.

FIRSTHAND REPORT

by Gary Witzenburg
DETROIT AUTO EDITOR



It was three years ago, late in 1977, when the Porsche+Audi Div. of VW of America unveiled its latest top-of-the-line luxury car, the four-door, front-drive Audi 5000. Roomy, handsome and agile on the road, the five-cylinder 5000 quickly attracted an enthusiastic following. Last year an economical diesel version was introduced, along with a new, smaller 4000 model to replace the Fox subcompact.

For 1980, Audi expands its product line to include a new flagship, the 5000 Turbo, and an automatic-shift version of the 4000 complete with the 5000's 100-hp, fuel-injected five-cylinder engine for extra zip.

At over \$16,000 for the turbo and \$10,000 for the 4000 with the five-cylinder engine, neither is bargain-basement material, yet both represent a lot of car for the price. "Our customers pay premium prices to obtain premium products," asserts Porsche+Audi Div. vice president James R. Fuller, "like buying a Tiffany watch from Tiffany's instead of a Timex from J.C. Penney." Those who have that sort of money to spend should find the Tiffany's comparison is a valid one, at least as applied to the 5000 Turbo, because it's a real jewel. With a 30-percent boost in horsepower over the standard gas-engine 5000, fed through Audi's smooth automatic transmission, it's a delight to drive.

Because of the nature of turbocharging, the engine acts perfectly normal at idle and at slow speeds. But put your foot down to pass or merge into fast-moving traffic, and you get a jetlike surge of power as engine speed increases—extra performance when you need it and only when ordered up from the helm. It'll do 0 to 60 mph in about 10 seconds and even delivers slightly better fuel economy in the city (18 mpg vs. 17) than the regular five-cylinder automatic 5000, provided you don't use the extra turbo power too often.

We tested Audi's new flagship on

(Please turn to page 126)



New 4000 is equipped with the nonturbo version of the 5000's five-cylinder engine.

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**and
sometimes
even mends
a broken
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The Saving Place

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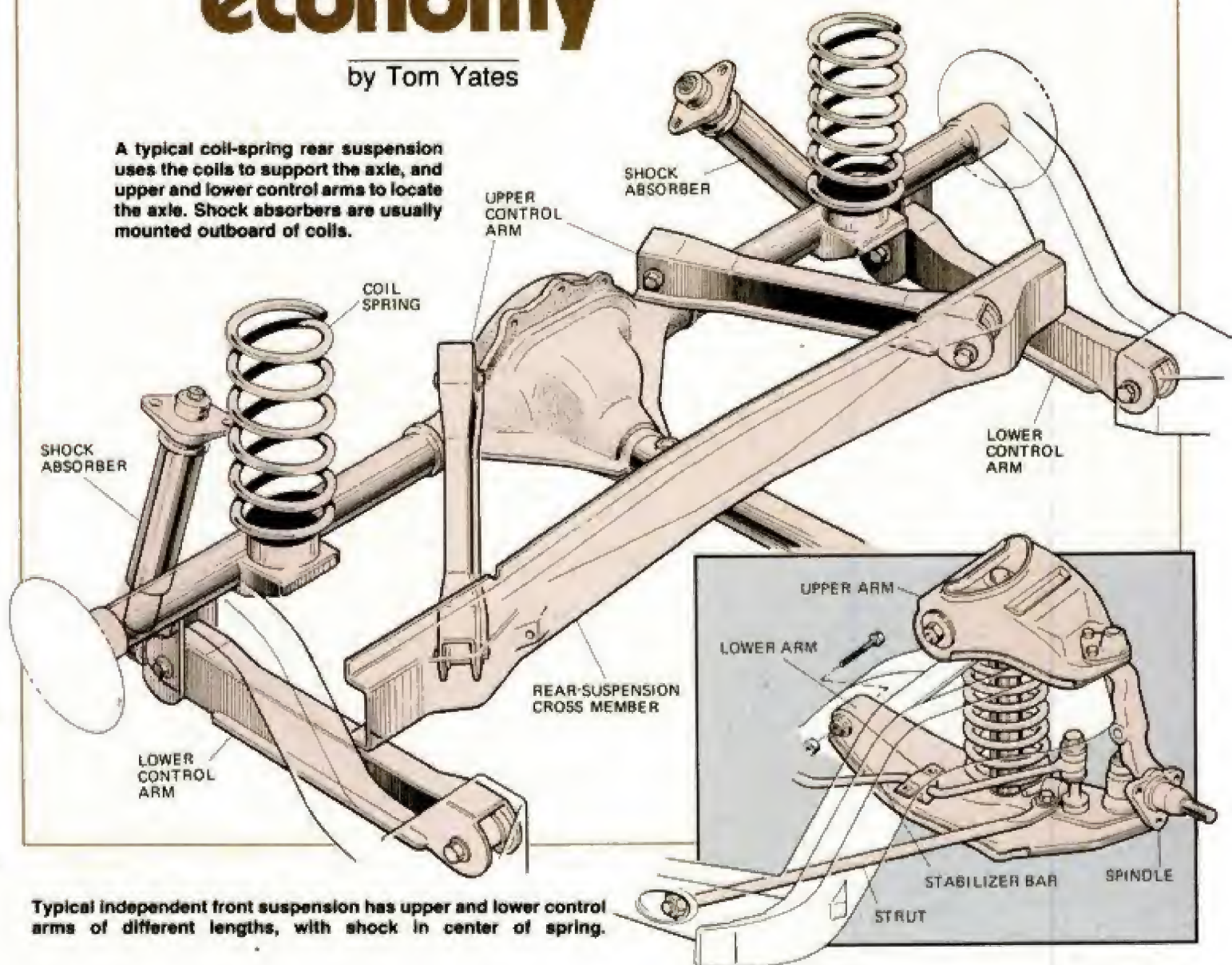
Kmart Corporation

Troy, Michigan 48064

Tuning your suspension for performance and economy

by Tom Yates

A typical coil-spring rear suspension uses the coils to support the axle, and upper and lower control arms to locate the axle. Shock absorbers are usually mounted outboard of coils.



Typical independent front suspension has upper and lower control arms of different lengths, with shock in center of spring.

Most people have only a vague idea of their car's suspension and chassis and what goes on down there. For the most part, the only time a car owner ever gets involved with the underside of his car is to change shock absorbers or do a chassis lube job. This is unfortunate because regular underside inspection and some preventive maintenance could save you a lot of time and money on major repairs, tire wear, shock-absorber life and even mileage.

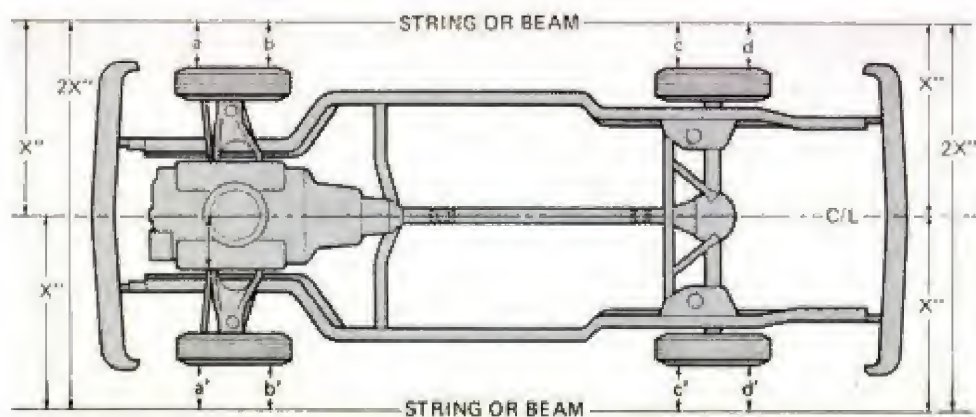
For instance, tires out of align-

ment, out of balance or improperly inflated can shave one or two mpg off your mileage. If the camber angle is off by one or two degrees, it will result not only in uneven and premature tire wear, but it could also adversely affect the handling characteristics your car was designed with.

Every suspension system is designed to accomplish two major jobs. One is to absorb irregularities in the road surface and keep them from being transmitted into the passenger compartment. How well the suspen-

sion performs this job translates into the type of ride it provides—a soft ride, a hard ride or any other increment on the scale from rock hard to ultra plush.

The suspension's other major task is to keep the tires on the road. This may sound like stating the obvious, but a badly tuned or worn suspension won't always do that. One example of the latter is a rear axle that chatters or skips over the surface. If you were to plot rear-axle chatter on a graph, you'd see that the rear tires spend half their time in the air and



Parallel reference lines must be established before measuring toe-in. Outside lines are measured from the center line.

Toe-in (above right) is measured from line to the rim. Use jack stands (right) to secure line and measure from center line.

half on the ground. This not only reduces braking power, but also lessens your control over the vehicle. Rear chatter is usually caused by rear springs that have gone soft or shocks that have gone bad.

This last function of the suspension has less to do with the quality of ride (although it can also affect it) and more to do with road feel and handling.

All modern cars have independent front suspensions. That means the right and left wheels are not connected by a common axle. Instead, the wheels are attached to spindles which carry ball joints at the top and bottom; these ball joints are, in turn, attached to upper and lower control arms. The control arms, also called A-arms, are different lengths. Suspensions with upper and lower control arms and coil springs can carry the coil spring, either on the upper control arm or on the lower one. In most cases, the shock absorber is fitted directly in the center of the coil spring.

On the new, smaller American cars, the McPherson strut is used. In this configuration, the strut is fitted with an integral shock absorber and a coil spring mounted at the top of the strut. With McPherson struts, there is only a lower control arm.

The rear suspension on most American cars is generally a solid axle that runs the width of the body, with the differential in the center. The rear axle is attached to the body by either coil springs or leaf springs. When leaf springs are used, they also serve to keep the axle in its proper location beneath the body. When coil springs are used, locating rods (also called radius rods) run from the body to the axle to keep it in its proper location.

Inspecting the rear suspension

Before beginning any inspection of the system, clean all the components thoroughly. The best way is to have the underside steam-cleaned,

but you could do a decent job with a grease-cutting solvent and a high-pressure water hose. A good cleaning makes it easier to see any damage, cracks or defects and it also reduces the amount of dirt that falls on you while you're working under the car (always use safety glasses when working under your car).

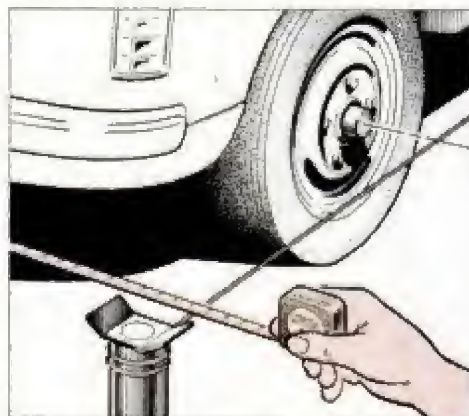
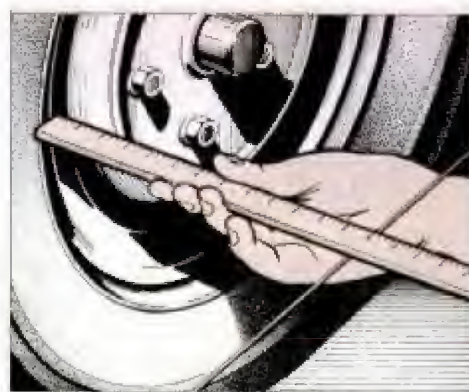
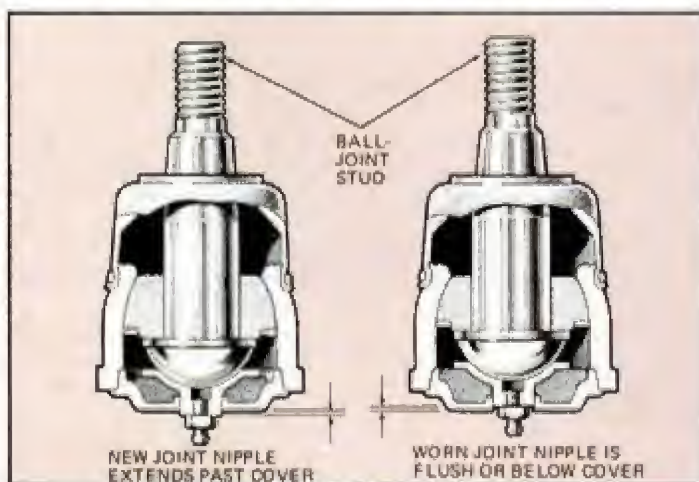
In order to set up the chassis and suspension properly, check the factory manual for recommendations about vehicle loading before making adjustments. Most manufacturers say that the oil and radiator levels should be at full and the gas tank be at least half full before you set ride height, camber and alignment. Also check that you have the correct air pressure in all tires.

At the rear of the car, check the leaf spring shackles for bending or cracks. Also examine the bolt that holds the spring to the shackle to make sure it isn't bent. Then look carefully along the edge of each spring for cracks, and also to determine if the individual leaves are stacked up correctly and not out of line with each other.

If you suspect any cracks in the springs, remove the whole assembly and examine the individual leaves.

If the leaf springs have flattened considerably and the car's ride

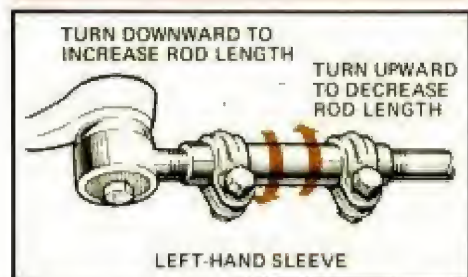
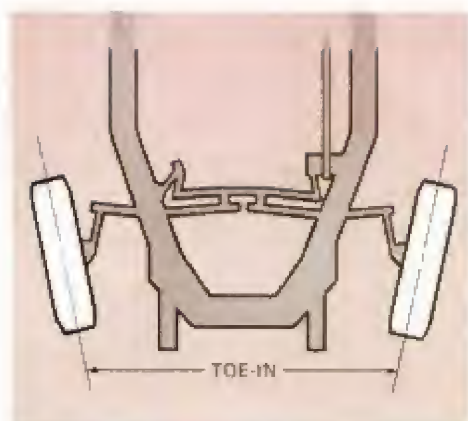
Most modern ball joints have wear indicators which warn you when a ball joint has outlived its usefulness. On some cars, ball joints cannot be removed, but the entire upper and lower control-arm assembly must be replaced. If your ball joints don't have wear indicators, use calipers to measure ball-joint height.



height is less than ideal, you have several alternatives to remedy the condition. You can either have the springs recurved and heat-treated, you can install longer shackles or buy new springs. The cheapest and fastest remedy is the longer shackle. While the longer shackle is a good temporary fix for a borderline spring, it isn't recommended as a permanent repair. Eventually, as the spring flattens even more, it will begin to curve upward, beyond the attachment point of the longer shackle.

The next remedy, having the spring recurved, is a better bet. The critical factor here is that the recurved spring should be heat-treated to maintain its tensile strength.

The last alternative is to go out and buy a new set of rear springs. But you might find it cheaper to have a pro rework the springs than



Toe-in and toe-out are adjusted by rotating the sleeve on rod. Left- and right-hand rods rotate in opposite directions.

to buy a new set, especially if you have an older car for which replacement parts might not be readily available.

If you have coil springs at the rear, check each coil for cracks and check the mounting plates for broken or missing shims. Also be certain that each coil is an equal distance from the coil above and below it, unless, of course, you have dual-rate coil springs. In this case, the coils will be closer together at the top of the coil and further apart at the bottom.

Next, check radius rods, trailing arms and all the bushings. If bushings are cracked, worn or missing, replace them.

To see if bushings are excessively worn, grab the rod or arm and shake it. If there is slop or too much action, replace the bushings. If the coil springs have sagged and lowered the ride height, the body can be raised by inserting shims between the coils and the coil spring mounting plate or the body.

Inspecting the front suspension

Jack up the car, put it on jack stands and remove the wheels. As with the rear end, check all bushings, grommets and rubber bump stops. If you notice the ends of the rubber bump stops are chewed up or worn, it's an indication that the suspension has been bottoming out and the springs and/or shocks are no longer usable.

The classic test for shock absorbers is to bounce the fender a few times and see how many times the car bounces after you release it. It

should stop bouncing almost immediately after you release it.

A thorough test of the springs is a bit more complicated, and the information you need may not be readily available. However, a good indication of spring condition is measurement of the ride height. A shop manual will tell you the suspension point from which the height should be measured. Some makers measure ride height from the bottom of the rocker panel, while others do it from the pivot point of the lower control arm.

In most instances, correct ride height is a good enough indication of spring condition. But, if you want to be really thorough, or if you suspect a bad spring, you'll have to measure the installed spring height and then remove the spring and measure the free-standing spring height. If the springs don't conform to factory tolerances, they should be replaced.

Examining ball joints

The components to examine next are the ball joints. Modern ball joints have wear indicators that warn you when the ball joints are worn. If you don't have this type, proceed as follows:

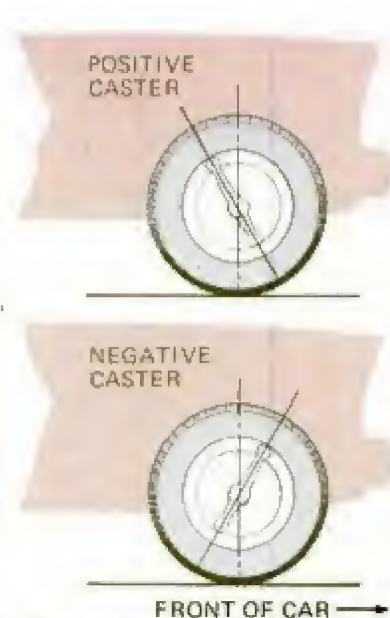
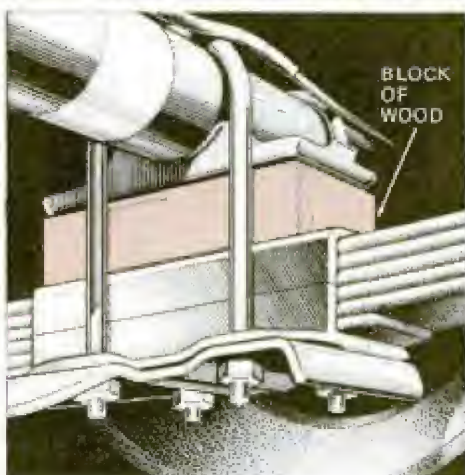
1. Measure the height of the load-bearing ball joint with calipers while the car is on the ground. The load-bearing ball joint is the one which is loaded by the spring. That is, if the spring is mounted on the lower control arm, that ball joint is the load-bearing ball joint. If the spring is on the upper control arm, that ball joint is the load-bearing one.

2. Jack up the car. With a second jack, compress the control arm to release the load on the ball joint.

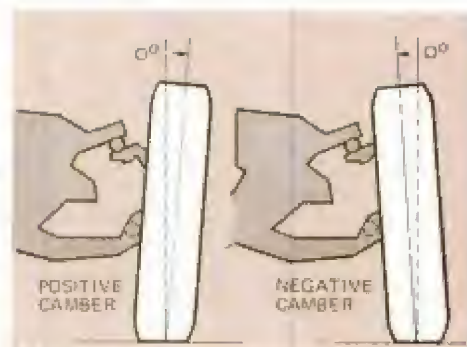
3. Measure the height of the ball joint again.

The differences between the loaded and unloaded position of the ball joint will indicate whether or not it is worn.

A good way to lower ride height is to place a wood block between axle and spring.



Positive caster (top) is the positioning of the top of the spindle to rear of bottom compared to a vertical line. The reverse is negative caster. Positive and negative camber (below) indicate the inclination of the wheel relative to a vertical line.

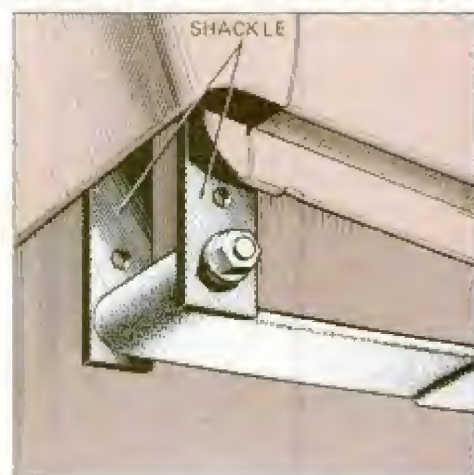


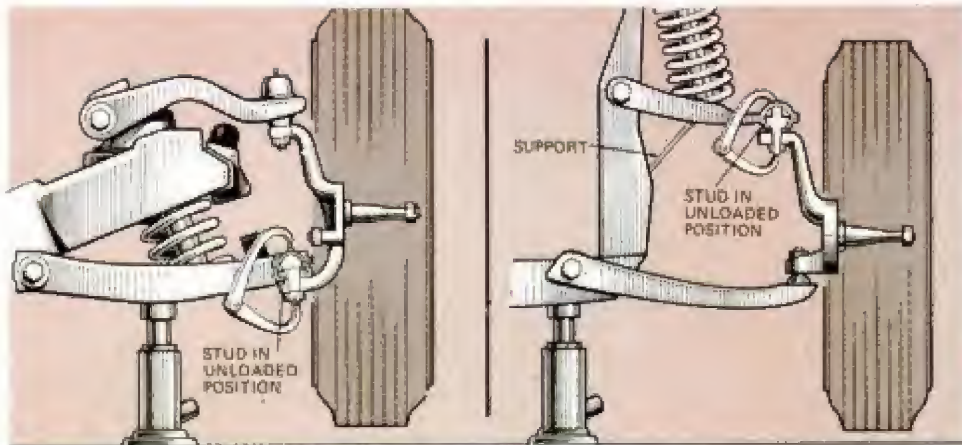
Checking toe-in

Before checking toe-in it's first necessary to set up a reference line against which to measure toe-in. To do this, you must first establish the center line (C/L) of the car. Measure between the pivot points of the two lower front control arms, and establish the center of that dimension.

Go to the back of the car and mea-

To raise ride height, you must use longer shackles on the rear-spring mounting eye.





On cars that have lower coil springs without wear indicators, support the wheel and measure the ball joint with calipers.

With upper coil springs, support the upper control arm and the car and measure for ball-joint wear with calipers.

sure the distance between the rear mounting eyes of the leaf springs and establish the center. Then, with a string and two jack stands, connect the center points of the front and rear.

With four more jack stands and two pieces of string, establish parallel lines on either side of the car. The strings must be the same height as the center of the wheels.

Turn the front wheels to the straight-ahead position and, with a good ruler, measure the distance from the string to the front of the rim and again at the rear of the rim. Remember that this measurement will be valid only if the rims are true. To check the rims, use a dial indicator to test for run-out while the car is raised.

Also keep in mind that each wheel should indicate half the total toe-in. That is, if your wheels need to have a total of $\frac{1}{8}$ -inch toe-in, each wheel should toe-in $\frac{1}{16}$ inch, as measured from your parallel reference line.

Caster and camber

Caster is a measurement which indicates the position of the upper and lower ball joints relative to a vertical center line. On a car with positive caster, the lower ball is further forward than the upper ball joint. Negative caster is the reverse. Most cars are set up for positive caster.

Caster can only be measured with a caster gauge, available through specialty tool manufacturers. Caster is adjusted by means of different sized shims at the front and rear upper control-arm attachment points. For instance, if you need more positive caster, install a bigger shim on the rear upper control arm attachment point. This cocks the entire upper control arm forward.

Camber is the angle the plane of the tire makes in relation to a vertical line, as viewed from the front of the car. There are various camber gauges available, ranging from \$20

to several hundred dollars. One of the best portable gauges is made by Wayne Mitchell Engineering, Box 2335, Leucadia, Calif. 92024.

Camber angle can be adjusted by using shims of the same size on the upper control arm attachment points, or by using eccentric bushings. Check your shop manual for the recommended procedure.

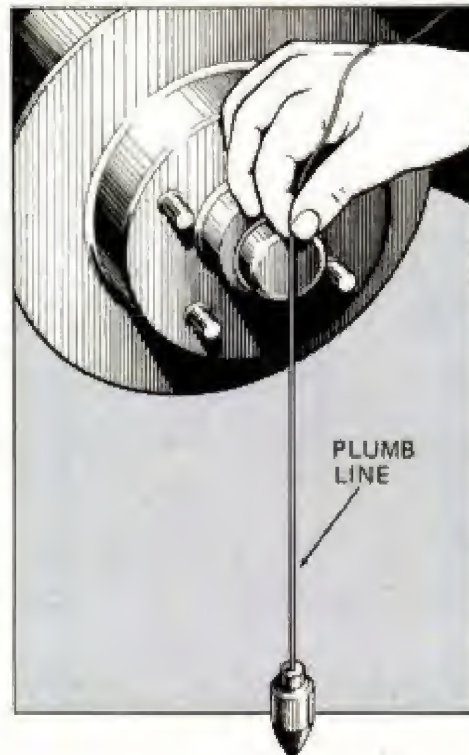
Squaring the chassis

A body shop will charge you quite a bit just to check your chassis for squareness. You can do it yourself for next to nothing. All you need is a plumb line, four jack stands and four jacks.

First, set all four corners of the car on jack stands and remove the wheels.

Next, compress the suspension with the jacks until the center lines

To measure chassis squareness, drop a plumb bob from the center of each wheel hub and mark the location on the ground.



of the four wheels are on the same plane. The parallel lines you set up earlier are good for this operation, too.

Drop the plumb to the floor from the center line of each wheel and mark the position of the bob on the floor. You can paint, use a grease pencil or whatever, as long as it's a good reference point.

Measure the distances indicated in the illustration. If the chassis is square, A should equal B in most cases. Sometimes, rear track width is different from front track width. C should equal D unless you have a Renault R5, which has two different wheelbases. E should equal F in all cases. If C and D are equal, but E and F are not, then it means the rear axle is cocked to one side. The solution is to unbolt it and slide it back into position.

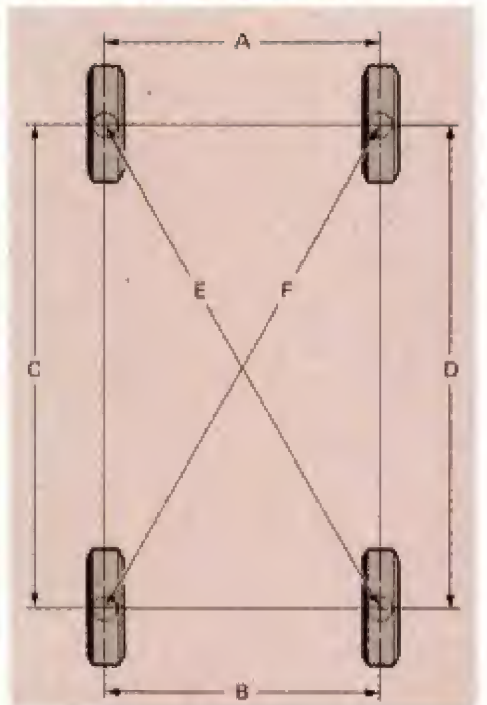
Another set of marks

If these measurements don't come out right, and you've double checked your work, make a second set of reference marks, this time using the suspension pivot points on the frame, not the suspension. If the frame reference points are square, then it means the suspension is out of line. If the frame reference points are off by the same degree as the suspension reference points, then the frame is bent and must be straightened.

You must take the car to a body shop and have them pull the frame on a jig. No amount of suspension tuning will compensate for a bent frame.

FM

When all marks are made, take measurements shown. If suspension is off, check again, using chassis mounting points.



Energy crunch creates new jobs for trained technicians.

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NRI Schools

McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Solar roofing

I am going to make a 21x35-ft. enclosure for my swimming pool. The walls will be continuous sliding-glass patio doors for good ventilation. To aid in winter heating, I'll have a sloping, transparent, flat roof on redwood framing. What type roofing material would be good? It would have to withstand sun, wind, rain, hail and snow.—Dale E. Watt, Tulsa, Okla.

Your local lumber dealer probably carries several brands of corrugated acrylic panels that are mainly used for shed-type protection over patios. Most allow light to pass through.

For a structure such as yours, facing the expense of continuous slid-

the sources mentioned above at these addresses: Filon-Vistron Corp., 12333 South Van Ness Ave., Hawthorne, Calif. 90250; Kalwall Corp., 1111 Candia Rd., Manchester, N.H. 03103; Kennedy Sky-Lites Inc., Box 17832, Orlando, Fla. 32810.

Electric fixtures on panel

When adding furring and paneling to a room, how can I bring the electric receptacle and switch boxes flush with the new wall? I've looked in several books on electrical wiring to no avail.—William S. Love, Perry Point, Md.

Your question is a tough one, but I found a product that can help. It's called Add-A-Depth Ring and is made by Raco. The ring allows quite a latitude of adjustments, depending on the thickness of the wall. If you can't locate the item, write to Raco, Box 4002, South Bend, Ind. 46634, for a nearby distributor.

Also see *PM Looks at Plug-in Outlet Extender* (page 220, Apr. '80).

Removing creosote stains

Creosote from the flue of my wood-burning stove has leaked onto the stove hearth. The stone is unpainted. How can I remove the stains?—Robert Posner, Monticello, N.Y.

First, call in a reliable chimney sweep to check your stove and metal flue. Contrary to popular belief, the male end of a flue pipe should point down. In a proper installation, any dripping creosote will then remain in the pipe.

As for removing the stain on your hearth, any cleaner containing phosphoric acid should do the job. One product is No Soot, a fireplace brick cleaner made by Chattahoochee Research Co., Box 12141, Atlanta, Ga. 30355. A pint bottle costs \$3 postpaid. Another is Cam-Kleen, a heavy-duty ceramic tile and grout cleaner made by Woodhill Permatex. It sells for about \$2 for 12 fluid ounces. Both cleaners are sold in hardware and houseware stores.

Be sure to follow the manufacturer's directions. Wear gloves, goggles and a long-sleeve shirt.

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

Spiral staircase

There is only an outside entrance to the basement that I intend to finish. As space is limited, I would like to install a spiral staircase in the corner of my living room for access to the basement. I have obtained the name of Duvinage Corp., but do you know of someone else who makes these stairs?—Herbert J. Mones, Selden, N.Y.

I assume you are comparison shopping, which is a good idea. There are many manufacturers of spiral stairs besides Duvinage, Box 828, Hagerstown, Md. 21740. You might also try Woodbridge Ornamental Iron Co., 2715 North Clybourn Ave., Chicago, Ill. 60614. Write for information.

Be certain to describe accurately to the manufacturer your exact condition, as minimum headroom and type platform can govern product choice. The installation is too lengthy to describe in detail, but the suppliers' tables and charts indicate critical dimensions, once you know the type of platform and the distance from floor to floor.

Most stairs come in knockdown kit form, can be assembled with common tools and require no welding on the job. They are packaged to fit through finished doorways. Prices vary, but for the situation you describe, \$900 would be a reasonable ballpark figure.

More on rising butt hinges

Bob Strong of Windsor, Ont., brings out a good point about rising butt hinges ("Carpet-clearing Hinge," *Homeowners' Clinic*, page 40, Feb. '80): The top of the door or jamb over the hinges may require a bit of shaping, because the door starts to rise as soon as it is opened.

His supplier has sets of three hinges available. These hinges are a good bargain, from: Consumers Bargain Corp., 404 Irvington St., Pleasantville, N.Y. 10570. **PM**



Kennedy's energy-saving Sky-Lite has two domes separated by an insulated air space.

ing doors and redwood, it would be wasteful to apply a roofing material that couldn't meet local severe weather criteria for perhaps more than one season. Check out insulated, translucent panels such as those made by Filon-Vistron Corp. and a slightly higher-priced panel manufactured by Kalwall Corp. The latter is a sandwich panel of fiberglass sheets bonded to a grid core of aluminum I-beams. You might also consider dome-type insulated skylights like those manufactured by Kennedy Sky-Lites Inc.

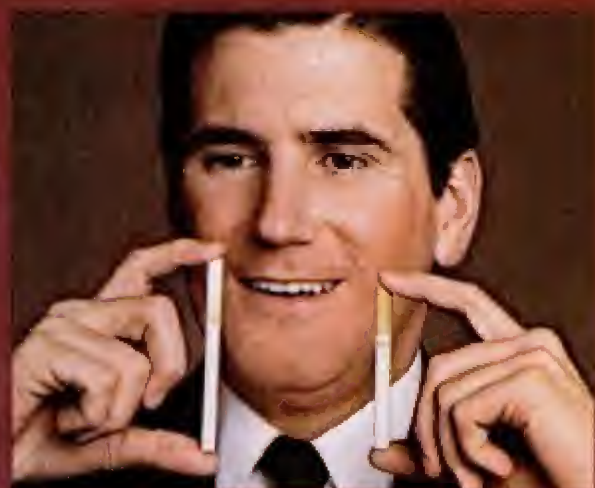
To cut costs somewhat, you can build a shed-type roof with gravel covering about 60 percent of the surface and translucent material covering the remainder. Also, from the standpoint of economics, you might consider using dry, pressure-treated wood (see *Protect Against Rot and Insects with Pressure-Treated Wood*, page 162, Mar. '80).

For brochures, you can write to



BY JOHN GAYNOR

A third less tar than the leading filter 85



Longer, yet lighter

Pall Mall Light 100's	12 mg. tar 0.9 mg. nic.
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Winston 85	20 mg. tar 1.4 mg. nic.
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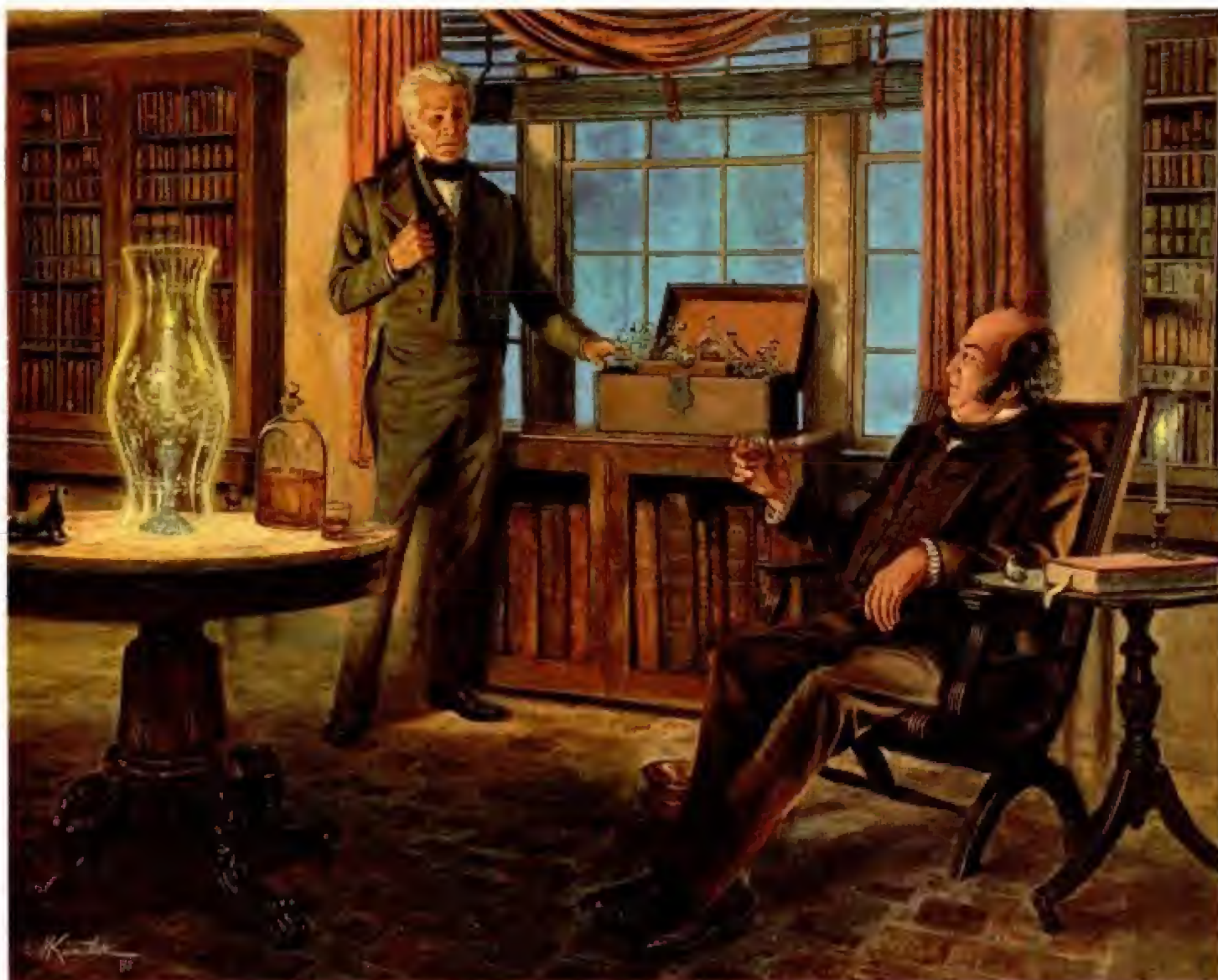
Lowest brand less than 0.01 mg. tar, 0.002 mg. nic.



PALL MALL LIGHT 100's

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

12 mg. "tar", 0.9 mg. nicotine av. per cigarette, FTC Report Dec. '79.



Andrew Jackson entertains Martin Van Buren.

Andrew Jackson, "Hero of the Plain People," enjoyed the simpler pleasures of life. To friends, like Martin Van Buren, he displayed his personal liquor chest. Jackson's decided preference for Old Crow is reported in a 19th-century newspaper.

OLD CROW

THE ORIGINAL SOUR MASH



**OLD CROW. THE PROUD TASTE
OF AMERICA SINCE 1835.**

Kentucky Straight Bourbon Whiskey, 80 Proof, Distilled And Bottled At The Famous Old Crow Distillery Co., Frankfort, KY

© 1994 Old Crow Distillery Co., Frankfort, KY

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Antacid relief

Even if you regularly wash your car battery with baking soda, acid deposits will eventually accumulate on it. If the problem is unchecked long enough, the acid could rot out the battery tray.

A new product called PRO-TEXTors solves the problem. They are



Insulators prevent battery-acid deposits.

chemically treated insulators which slip over the battery posts beneath the cables. I've had them on for several months and they certainly work. PRO-TEXTors, guaranteed for the life of the battery, cost \$3 from Martin Associates, 57 Richmond Rd., West Chester, Pa. 19380.—B.H.

Lash it down

On a recent parts-scavenging trip, I had a chance to test a new cargo strap made by Nelson-Dunn. The product is called Strap-All and it really did the trick. I loaded a bunch of body and engine parts onto the roof rack of a station wagon and lashed it all down with the Strap-All. The advantage of the Strap-All is that it



Nylon strap with ratchet secures cargo.

has a ratchet handle which lets you apply tension and lock the strap in place without allowing any slack. And since it's made of nylon, it won't

scratch the paint if it rubs against your car or truck body. It's also much handier to use and stow away than a coil of rope or chain. It costs \$15.89 and is available through Nelson-Dunn, 940 South Vail Ave., Montebello, Calif. 90640.—T.A.

Forward vision

The information on the bottle says it's made of "isomeric polymers solubilized in isopropyl alcohol which forms a hydrophobic monomolecular film."

It's a good thing that you don't have to be able to say it in order to use it. The product is called Rain-X and it's one of the best safety items I've come across in a long time. Originally developed for airplane windshields under a different name, it is now available for your car wind-



Invisible shield repels water, road dirt.

shield. You apply it to a clean windshield with a cloth and forget it. You won't notice it's there until it rains. And when it rains, you'll be glad you used it.

The invisible shield it leaves on the glass acts as a water repellent, and water simply beads up and blows away. Most of the time you won't even need to use the wipers—unless rain is unusually heavy.

It costs \$4 for an 8-oz. bottle and is available at most auto retailers. For more information, contact Unelko Corp., 506 Taft Dr., South Holland, Ill. 60473.—T.A.

Snow removal

A new type of wiper blade has just been introduced by Anco, a leading maker of replacement wiper blades. Called Snow Blades, the new blades differ from conventional types by being encased in a flexible, 100-per-

cent rubber covering. The rubber bootie prevents ice and snow from building up on the blade's movable metal parts. The wider area of the rubber also acts as a mini-snowplow to push snow out of the way. They



Booted Anco wiper blades remove snow.

cost about \$12 per pair, depending on the size, and are sold wherever Anco wiper blades are available. For more information, contact Anco, 1075 Grant St., Gary, Ind. 46440.—R.N.

Lifetime muffler

Here's some good news for budget-minded Saturday mechanics. Maremont has just introduced its Turbo-Flow replacement muffler and offers a lifetime warranty with every unit.

Unlike most replacement mufflers, Maremont's Turbo-Flow is coated with a crinkle-finish black paint for added corrosion protection.

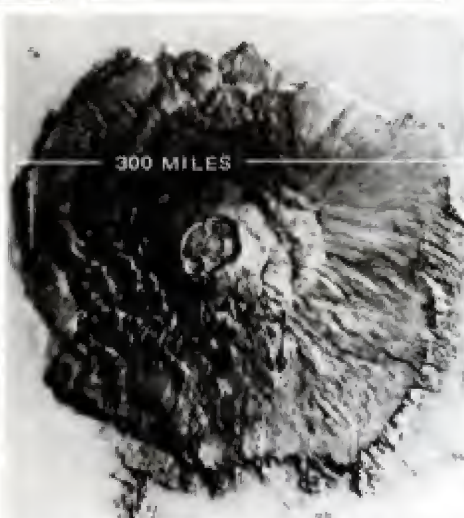


New muffler offers a lifetime warranty.

The Turbo-Flow is available at retail outlets, jobbers and gas stations. But, wherever you buy it, and regardless of whether you install it yourself or have a mechanic do it, the lifetime warranty is always valid. The muffler is priced at less than \$40.

For more information, contact Maremont Exhaust System Products, 200 East Randolph Dr., Chicago, Ill. 60601.—T.A.

SCIENCE WORLDWIDE



Nevada-size volcano towers 15 miles high.

Spectacular Mars

Mars may be smaller than Earth, but a new first-ever atlas of the "Red Planet" displays surface features dwarfing our natural wonders.

The 146-page atlas covers the Martian surface—55.7 million square miles, or about a quarter that of Earth. Among the spectacular features is the volcanic mountain, Olympus Mons (photo, above), with an area roughly that of Nevada.

The atlas, based on more than 10,000 photos of Mars taken from spacecraft, is available for \$7 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Mixing microwaves and drugs

Battelle Labs scientists are studying whether microwave signals amplify the effect of drugs in the body.

The U.S. Navy ordered the 40-month study out of concern for sailors exposed to microwave radiation from on-board radar. "People are occasionally exposed to microwave bands," said Dr. Richard H. Lovely at Battelle. "The wavelength may be so short that their bodies aren't resonant, but parts of their bodies might still interact with the field and capture a lot of energy. We start to get concerned when one of those parts is the head."

A study by the Navy published last year showed that one commonly prescribed tranquilizer, chlordiazepoxide, seems to gain potency in rats exposed to even low doses of microwaves. Lovely will try to confirm the Navy's results. But he'll also ex-

plore the effect of microwaves on learning, and he may test the effect of mixing microwaves with drugs like caffeine and alcohol.

Lovely said microwave ovens produced exposure levels far below those used in his research.

Magnetic bacteria

The bacteria in a drop of mud under a microscope were behaving like homing pigeons, all steadily moving in the same direction.

Richard Blakemore, a graduate student a few years ago when he first tracked the one-way bacteria, guessed the organisms were picking up signals from a lighted window. But they kept up their single-minded movement even when the microscope was covered by a box, or at night. Then he held a small permanent magnet near the drop. "It caused the bacteria to swerve," he told us, "go into a large U-turn and head toward the north pole of the magnet."

Since then, Blakemore and others have dissected the unnamed bacteria and found chains of magnetic crystals that apparently act as tiny compasses. But why would the bacteria head north?

It turns out, Blakemore told us from his lab at the University of New Hampshire, that the organisms don't care about north. Aiming at the earth's north pole, they wind up heading downward, into richer sediment.

The research may solve a basic problem in studying bacteria: It's hard to measure their growth rates in nature. Investigators could "tag" bacteria by placing them in strong magnetic fields, changing their polarity and that of their offspring, and release them in a natural setting. It would be easy to follow their growth by periodically counting organisms that are swimming the wrong way.

The great Stanford quark hunt

Scientists at Stanford University popped champagne corks recently at the inauguration of a new device to hunt for the elusive quark, hypothetical building block of all matter. But Pier Oddone, coordinator for the \$78-million experimental project, told us it might be months or years—if ever—before quarks are mined out of the debris of smashed subatomic particles.

The centerpiece of the Positron-

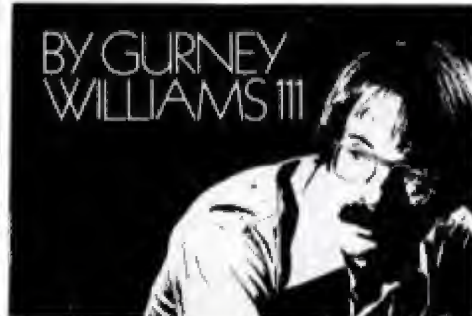
Electron Project (PEP) is machinery to do the smashing and record what happens. Batches of electrons whirl one way through a circular 1.5-mile track. Batches of positrons, particles with the mass of electrons but an opposite electrical charge, whirl the other way. The two clouds of particles are forced to collide at a spot about a tenth of a millimeter square. Each electron-positron collision creates a tiny fireball of pure energy from which new particles of matter will condense. Using sensitive detectors, scientists scout the new parti-



Mirrors in one PEP device, used in quark studies, deflect light from fast-moving particles onto phototube for measurement.

cles, looking among other things for quarks.

One reason the hunt is difficult, Oddone told us, is that electrons and positrons are so small it's hard to make them collide. "It's like a dilute swarm of mosquitoes, each a mile away from the other," he said. "The chance of two mosquitoes colliding is small." A similar device in Hamburg, Germany, has been on the quark trail almost two years. At press time, no quarks had been found in the collision debris. **PM**



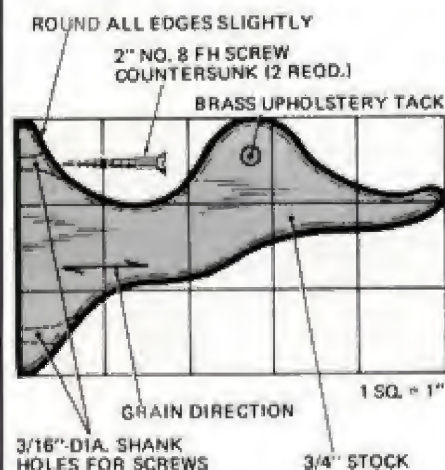
HINTS FROM READERS

Duck-head hangers



Use this duck head as a clothes hook or make two to hold a rifle. Cut them out using a bandsaw; smooth edges with a drum sander in an electric drill. Finish smoothing them with a flap-type sander. Bore screw pilot holes; countersink. Finish and add brass eyes.

—George Trout



Pan aids drill-press work



An aluminum pan is a helpful drill-press accessory. You can bend it as needed to get into restricted areas and catch debris as you clean.—W.E. Burton

**The used
aluminum can.
Crushed, bent,
scratched, smashed
...and valuable.**



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paid recyclers \$45,000,000.**

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You can recycle much more than just aluminum beverage cans. To find out how much Reynolds pays and what other aluminum items can be easily cashed-in at Reynolds, check the yellow pages under "Recycling Centers", or, call this toll free number and mention Popular Mechanics.

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Reynolds has proved recycling aluminum works. And proved what profits the country can profit the individual, too. So join us.



APPLIANCE CLINIC

QUESTIONS ANSWERED

Dishwasher runs dry

I have a 6-year-old Sears Kenmore dishwasher, model No. 587-721300. While the machine is running, water siphons out during the wash cycle. The drain hose is extended over the machine to prevent this, but it still happens. What can I do about this?—Pete Badolato, Marietta, Ga.

Check the drain hose to make sure the siphon break loop is correct. The drain hose should go from the bottom of the dishwasher up to the underside of the countertop and preferably be secured to the top with a clamp, as shown in the drawing below. Then the drain hose should slant down and attach to the dishwasher tailpiece under the sink.

If the hose position is correct, check the timer. The motor must reverse direction to pump out the water in the tub. An erratic timer could be causing the motor to reverse itself during the wash cycle.

An easy way to test the timer is to open the dishwasher door, unplug the motor-harness connection at the motor, close and latch the door, and turn on the dishwasher to the first fill cycle.

The water will fill, then stop. Listen for any siphoning action. There shouldn't be any. Open the door, reconnect the motor harness connection, and then relatch the door.

Let the motor come on and listen for any siphoning action. If you see

or hear any, replace the timer located behind the control panel.

Pent-up heat

We have a General Electric dryer that runs for about a half hour and then stops. A half hour later, it starts up again. We placed the dryer in an old pantry under a cupboard. Do you think the dryer gets too hot, or is the problem something else?—Ted Oldham, Lewiston, Minn.

It does sound as if your dryer is starved for air. A dryer pulls in surrounding air, moves it across the heat source, circulates it inside the drum, then pushes it out the exhaust duct.

If the room is small or the dryer isn't vented, the surrounding air becomes stale, warm and moist. This could cause the motor to heat up and kick out on overload. As soon as the motor cools, the overload resets and the dryer starts again.

Pull your dryer out of the pantry and do a load of clothes. If it works okay, then the dryer was starving for air and you should permanently relocate it. If not, I would check for lint accumulation in and around the motor. Periodically vacuum all lint around the vents, drum, inside surfaces and the heat source.

Off-on switch

I own a Westinghouse electric range, model No. KEH3D, serial No.

J505479. The switch that controls my right front burner keeps the indicator light on even though I shut it off. I checked the switch and found that a terminal contact was electrically hot when the switch was in the OFF position. What causes this malfunction and how can I correct it?—Matthew J. Foley, Woodridge, Ill.

The fact that one of the terminals was electrically hot in the OFF position is evidence that the internal contacts in the switch are either stuck or arced closed. This could have been caused by a number of factors, such as age, use and moisture.

We would replace the switch. One note of advice: Make sure the replacement switch is the proper one for your range. Carefully read the instructions before you install the new switch. An error could destroy the switch the first time you turn it on. Disconnect the range from power before making the installation.

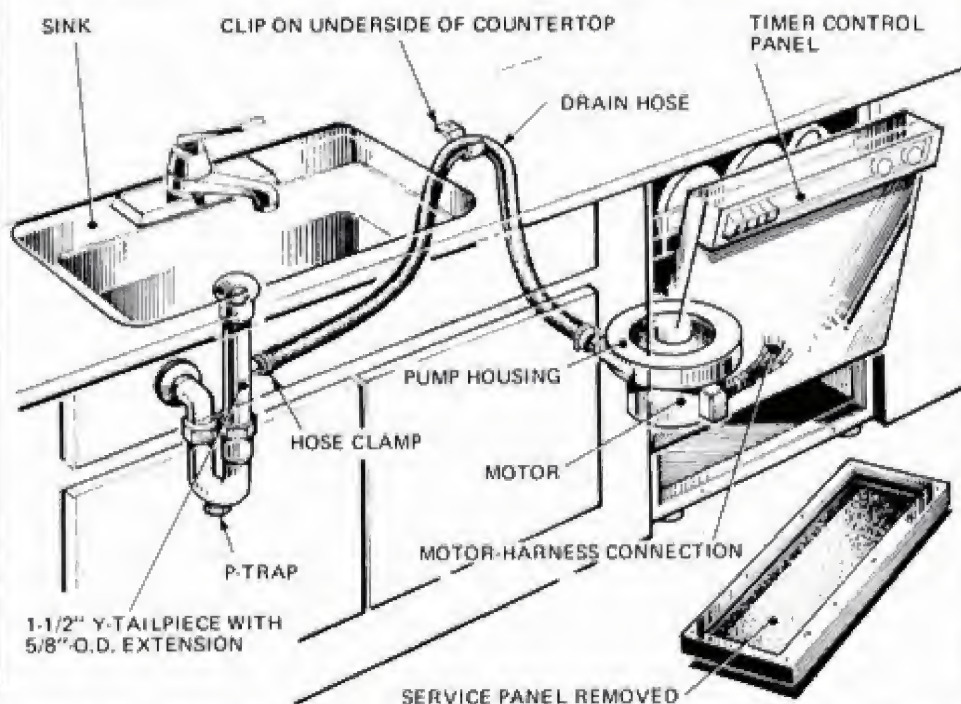
Out-of-balance washer

I have a Maytag washer with a faulty out-of-balance mechanism. It is a combination switch with the lid. The switch itself works, but the out-of-balance mechanism does not. I tried to adjust it, but it still doesn't work. Is there a special way of adjusting it or do I have another problem?—L. Conrad, Depew, N.Y.

The first check to make is for a broken or missing spring on the bracket assembly. The spring is designed to reset the unbalance lever every time the lid is raised. If it is broken or missing, the unbalance lever will never be pulled back up onto the switch.

Next, make sure the spring bracket and plunger aren't broken or sticking. Clean them both and check to make sure that they work easily. If any of these parts is in question, you can replace the assembly for about \$3.50.

To adjust the mechanism, just loosen the two screws by the switch and slide it either forward or backward. Then retighten the screws. Test the washer in the spin cycle with some clothes and water. Readjust the mechanism if needed. **PM**



Properly attached drain hose rises from the washer to countertop, then falls toward sink.

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Did you know?

Here are some interesting facts that may help you:

■ A faucet that leaks a drop a second may waste 60 gallons of water a week. (That's a lot of money if it's the hot-water faucet.)

■ Many common household plants are poisonous. Keep children from chewing on plants such as philodendron, dieffenbachia, poinsettia and begonias; they can be fatal.

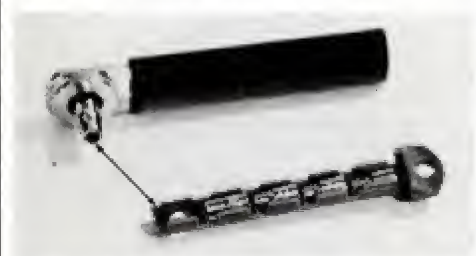
These and more tips are in the *Consumer Information Catalog*, free from Consumer Information Center, Pueblo, Colo. 81009.—H.W.

Pocket socket set

This six-piece, 1/4-in.-drive socket set features a handle that holds five sockets, from 3/16 to 3/8 in., in an integral, removable, spill-proof tray. It's compact enough (1 1/2 x 7 3/4 in.) to be



This well-built wrench set conveniently carries five sockets in its handle. The useful tool is available for under \$20.



carried in a pocket, and it weighs just six ounces. The Pocket Socket has a removable thumbwheel ratchet for tight jobs. It's about \$18 at hardware and auto-supply stores, from Litton New Britain Tool, Box 1320, New Britain, Conn. 06050.

—H.W.

Adjustable pilot drills

This set of completely adjustable pilot drills boasts four sizes to accommodate Nos. 5, 6, 7, 8, 9, 10, 12 and 14 wood screws in all common lengths up to 2 in. It is claimed to replace as



Handy four-bit set (above) replaces more than 30 bits in your drill box. Set countersinks and counterbores (below).



many as 36 conventional pilot and countersink drills.

With simple adjustments, you can bore a pilot hole for the thread portion of the screw, a shank hole for the body, and countersink or counterbore in one operation. A stop collar permits repeat drilling to a set depth. Seru-Drill is manufactured by Disstim Corp., 207 West Evesham Rd., Runnemede, N.J. 08078. It's available at hardware stores for about \$14.—R. Capotosto

Low-cost magnetizer

In my opinion, no workshop or toolbox should be without a tool magnetizer/demagnetizer. This little beauty sells for \$2.99 and takes up little space in a tool-box. When turning screws in hard-to-reach places, it



To magnetize a tool, simply insert it into the magnetizer several times and remove it.



One treatment has this screwdriver holding screws tightly for one-hand installing.

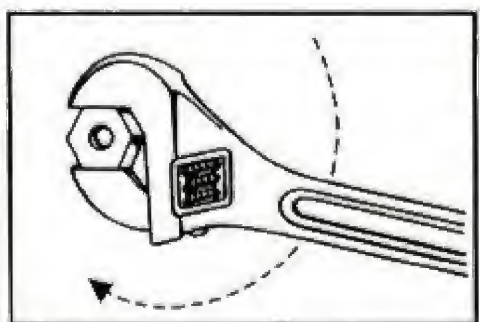


It's just as easy to demagnetize a tool: You simply rub the tool against rounded side.

can be slipped over the driver's shank for full magnetic power. It's sold at hardware stores or direct from Jay-Gee Manufacturing Co., 4191 Southwest 11th St., Fort Lauderdale, Fla. 33315.—H.W.

One good turn

The surest way to better craftsmanship is to use tools properly. According to the Hand Tools Institute, a loosely adjusted (adjustable)



Pull the wrench as shown to tighten the nut; reverse the wrench to loosen the nut.

wrench can slip, causing damage to nut, wrench and, possibly, user. For the best use, tighten the jaws to the nut securely, and pull the wrench as shown.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



JOIN THESE SHARP-ALL MONEYMAKERS

"Think the world of my Sharp-All. Am grossing \$4,000 a year on a part-time basis."

*Lawrence Stevenson
E. Syracuse, New York*

"There's excellent profit in sharpening . . . we now do about \$600.00 a month."

*Ed Kissel, Jr.
Sarasota, Florida*

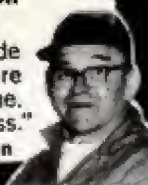
"I average \$5.00 an hour part time and business gets better all the time."

*Roy Jennings
Sandwich, Illinois*

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'What to do if you're teed off at athlete's foot.'

by Hale Irwin



"The only way I can keep my feet feeling up to par is to use Dr. Scholl's Solvex® Athlete's Foot Products."

When you feel the first itch of athlete's foot, just apply Dr. Scholl's Solvex Ointment or Spray. Solvex kills athlete's foot fungi on contact. And helps control the itching and burning of athlete's foot.

And, if you want to beat the itch before it starts, try regular applications of Dr. Scholl's Solvex Powder. It absorbs the moisture that athlete's foot thrives in and helps prevent reinfection.

"Face it, who knows more about feet than Dr. Scholl's? Their Solvex keeps my mind off my feet. And on the ball."

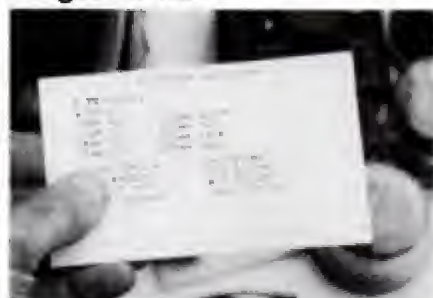
DrScholl's



© 1979 Scholl, Inc.

PHOTO HINTS

Forget-me-not



When packing or repacking photo gear, it's easy to leave behind a minor accessory or even a lens if you're in a hurry. An inventory card kept in your bag lets you check off each item as it goes in.

—Bob Berger

110 on a tripod



A ¼-20 nylon nut glued to the base of a 110 camera makes it suitable for use with a tripod. Cyanoacrylate glue works well.

—Charles F. Dayton

Rock around the clock



Tape a ¼-inch rod, slightly off center, to the underside of a developing tray. When prints are in the solution, set the tray rocking. The liquid will surge to and fro several times before stopping. By repeating this agitation every 10 seconds or so, prints will be more evenly developed.

—Robert Hertzberg

Foiled again

Cardboard covered with aluminum foil can be used as a reflector to bounce sunlight into shadowy areas when shooting outdoors.

—Margaret Shauers

YOUR FIRST SALE WILL PROVE IT!

The Big Ones Come Fast with Seamless Spray ENERGY SAVERS!

Through a series of circumstances created by inflation, I can now offer one of the most unusual opportunities in the history of direct selling. And best of all, you need no specialized experience to handle it. Absolutely none whatsoever!

If you've done any selling at all you know you can't make it anymore selling nickel and dime items. You can't afford to bust a gut selling a half dozen orders a day and wind up making \$25 to \$30. You need a necessity that everybody needs — that's quickly and easily sold because it solves problems born out of the inflation.



We call our process SEAMLESS SPRAY. It fills a vacuum created by the soaring price of new roofs. Roofs everywhere are leaking — in desperate need of repair. Using our Seamless Spray Equipment, factories, plants, shopping centers, schools, hospitals, apartment complexes use their own maintenance people to renew, waterproof, insulate these roofs at a cost of less than 12 cents per square foot. They save money, save energy, too. We loan

equipment absolutely free. On the average Seamless Spray order you make over \$500. You need absolutely no experience in our business. Our program is organized step by step for easy, successful use whether you sell General Motors (they are Seamless Spray users) or the corner garage.

When I tell you, PACE saved one school \$28,400 with Seamless Spray roof renewal, you'll understand how fast you eliminate sales resistance. Your market is pre-sold. Roof contractors with their exorbitant prices hand you the business on a silver platter.

Give PACE as little as 8 hours a week — that's all we ask. Once you start making \$500 and more on one Seamless Spray order, then you'll consider full time PACING. In addition to Seamless Spray you'll also get our Siliconized PARK-KING Blacktop Sealer — our Liquid Metallic Siding, another Energy Saver that gives winter and summer insulation — and a complete line of highly specialized Labor-Saving One-Coaters designed to save big money on all kinds of building maintenance. Each meets the BIG SELL concept, where you can make a Big Pay-check every day you make calls with Pace.



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Dan Mathews ..	1,213.25	Ed Donaldson..	1,175.25
Larry Richardson	890.82	Glynn Lewis ...	1,387.44
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Cayle McAllister	\$484.51	



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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Two years too late

Since the day I purchased my 1978 Ford LTD with 400-cu.-in. engine in December 1977, it has surged when being driven on the highway. The car, which now has 19,000 miles, acts as if it's not getting the proper amount of fuel. I've taken the car to three different Ford agencies. None have been able to correct the problem. I've been told that Ford was having trouble with this engine, but I've been assured a solution is imminent. How much longer must I wait?—Fredrick R. Martindale, San Pierre, Ind.

No longer. The solution you've been seeking came to light 2½ years ago, in the form of Article 3199, Service Bulletin 158 (5/23/78). Among other things, it calls for replacing the carburetor main metering jets with a different design (part No. C3TZ-9533-C), changing the float-level setting, installing a connector (part No. 383003-S) in the hoses to the air-cleaner bimetal sensor and installing an EGR restrictor (part No. D8AZ-9P753-A) between the EGR valve and the spacer.

Although your car has 19,000 miles and is no longer covered by warranty, you shouldn't have to pay a cent to have it fixed. After all, the dealer fouled up by not checking his service bulletins. If you get any flak over the bill, demand to see a Ford zone representative.

Save your turbocharger

In reference to your advice on the GM turbocharged V6 engine a while ago (Feb. '80), I came across an article in PRO Sales and Service that reports a prime cause of turbocharger bearing failure—even more so than not changing oil every 3000 miles, as you emphasized. The procedure is a little more than what a dealer might normally do, so I'm passing the tip along, hoping you'll convey it to PM readers.—Ed Braithwaite, Forest, La.

Thanks, Ed. This is one of those tips which come along once in a blue moon that can save a guy *beaucoup* bucks for a new turbocharger. Says

PRO Sales and Service, which is published by Chevrolet:

"Many 1980 Monte Carlo models equipped with turbocharged V6 engines require special procedures when the oil is changed. Oil and oil filters should be changed every 3000 miles. When refilling, however, technicians must prime the oil feed line to the turbocharger. Running at 120,000 rpm, the turbocharger could be ruined without oil. These are the steps to prime the feed line:

- Disconnect the ignition feed wire from the distributor.
- Crank the engine until the oil warning light turns off.
- Reconnect the ignition wire.

This procedure will bring up the oil pressure without the possibility of the engine starting."

Although the article applies to the Monte Carlo with turbocharged engine, the advice is applicable to all turbocharged engines.

Master charge

I recently experienced a problem with my 1978 Plymouth Horizon which seems to be common with Horizon and Omni. The alternator ceased to provide output, and the battery was drained of power. Cleaning oxidation from the alternator-output

terminals and mating harness connectors appears to be a temporary fix, but I believe Horizon-Omni owners would appreciate any information you might have concerning how to make a permanent fix.—Francis J. Donnelly, West Milford, N.J.

No sooner asked than done. Inspect the alternator field terminal connections for:

- Loose wiring-harness terminals and signs of melting terminal insulators.
- Signs of arcing or overheating.
- Distorted or bent terminals.

If any of these conditions exist, field connections should be replaced, using Service Package 5211772. The procedure is outlined in Service Bulletin 08-27-79 (11/5/79). It applies to 1979, as well as 1978, Omni and Horizon.

There are two other service bulletins regarding inadequate alternator performance on these two cars to which a dealer's attention should be drawn. One is No. 08-21-78 (8/7/78), which discusses an intermittent loss of alternator ground on Omnis and Horizons built before May 1, 1978. The procedure calls for installing a new ground strap (part No. 5211756), using a new cadmium-plated through bolt (part No. 5206804) on the alternator housing.

The other service bulletin is No. 08-17-78 (4/17/78), which discusses the critical role of proper alternator drive-belt tension on alternator performance.

Waving the yellow flag

I recently took my 1978 VW Rabbit with gasoline fuel-injected engine to the dealer for a tune-up to correct a rough-running problem on initial start-up. The car has 26,000 miles on it. I was told that the injectors were becoming plugged, largely due to

(Please turn to page 58)

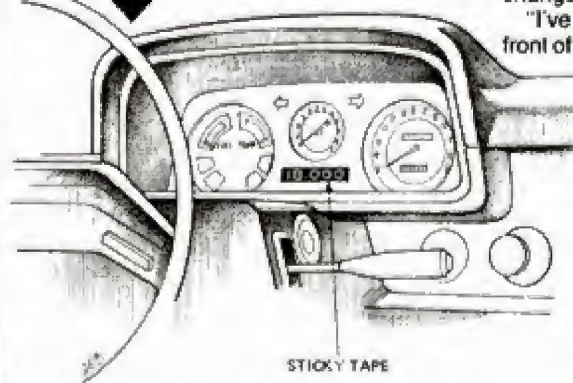



Standout stickout

Ken Kosiorek of East Bethany, N.Y., offers this splendid tip: "When you have your oil changed by a dealer or service station, the mechanic usually places a sticker recording mileage on the door jamb. Many drivers forget about this and, thus, exceed the recommended oil change interval," writes Ken.

"I've got a way to keep that information in front of me all the time. When I change oil, I use a labeling gun to stamp out on sticky plastic tape the mileage at which I next want to change oil. I stick the strip on the speedometer window where it doesn't interfere with the instruments. I haven't forgotten to change oil since the day, some years ago, I thought of this idea."

Thanks again for a great tip, Ken. Your engine will reward your thoughtfulness with years of hassle-free service.



A vintage advertisement for Marlboro cigarettes. The background features two men in cowboy hats and western attire. The man on the left, with a mustache, wears a brown vest over a red shirt and holds a lasso. The man on the right wears a brown shirt and is lighting a cigarette. They are standing next to a rustic wooden fence. In the foreground, two packs of Marlboro cigarettes are prominently displayed: a red pack for Marlboro Longhorn 100's and a yellow pack for Marlboro Red 100's. The overall tone is warm and nostalgic, evoking a sense of the American West.

Come to where the flavor is. Come to Marlboro Country.



**Marlboro Red or Longhorn 100's —
you get a lot to like.**

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine av. per cigarette. FTC Report Dec. '78

CAR CLINIC

(Continued from page 56)

"bad" gas, and that it would soon cost me \$500 to replace them. Isn't there some simple method of cleaning this costly injector system, so it doesn't have to be replaced?—Gary L. Myhre, Willmar, Minn.

Watch it, Gary. There's a chance you may be talked into spending a lot of money needlessly.

Replacing the injectors should cost \$20 to \$30 an injector—a total of \$80 to \$120. However, if the dealer is saying that the main fuel-metering regulator also must be replaced, then the \$500 tab is about right. It's rare, though, for that regulator to go bad in 26,000 miles. VW has not experienced any appreciable rate of regulator failure.

There is a way of cleaning injectors in an attempt to avoid replacing them. But the dealer you patronize has to be equipped with an injector pump, which is often referred to as a "pop tester." The unit produces high and sudden pressure to blow out injectors and test their spray pattern.

All in all, if I were you, I would consult a few more dealers, or shops specializing in fuel injection sys-

tems, before committing myself to a \$500 repair.

Just plain mad

In your March 1980 column, you said 1971-73 Capri models were being recalled to repair a problem that may cause the front seat to collapse backward. I've asked a local dealer about this recall (I have a '73 Capri with this exact problem), and he said, "No such thing." Whom can I contact to

get this repair made?—Dennis P. Roz, address unknown.

Man, if this doesn't burn a guy up! Tell that dealer the Ford recall campaign number is 368. Tell him, also, that if he doesn't get off the spot and make the repair, you want to see a service representative from the Ford zone regional office. If he still refuses to act, get in touch with the Ford Customer Service Dept. in Dearborn, Mich., and also call the

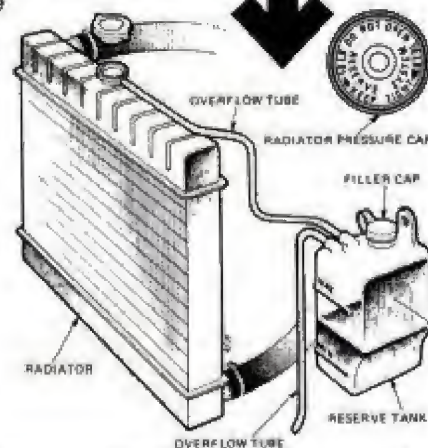
Full recovery

Coolant-recovery units are practically standard on new cars. The system consists, essentially, of a tube that is connected to a clear-plastic reservoir from the radiator. As the temperature rises and the coolant expands, instead of it being lost out the open overflow tube, as is characteristic of older cars, coolant flows into the reservoir. Coolant loss, therefore, is averted.

Older cars can now have coolant-recovery systems. Many companies make units that can be easily installed. One such kit (No. 3-2505) is made by Mopar to fit any make of vehicle. It consists of a reservoir, tube and special hard-to-open radiator cap. You can get it from a Chrysler dealer.

There are others on the market that can be purchased from other car dealers, or from auto supply and accessory stores for as little as \$3.95. The reservoir is mounted in a convenient location near the radiator.

PM CAR CARE



New from Stewart-Warner

Mini-Panel

The world's smallest instrument panel alerts you to car problems before they cause costly damage.

Mini-Panel is the miniaturized early warning system that helps you spot problems that develop while you drive. (Unlike traditional warning lights that don't go on until it's too late.) Catch those problems early, and you'll save yourself a lot of grief, as well as expense.

Each gauge serves an important function, enabling you to monitor electrical, cooling, and oil pressure systems at a glance.

Mini-Panel is so compact you can mount it on top of your dashboard—without obstructing your view of the road.

It's easy to install,* with no drilling or bolting. No unsightly wires, so you have a professional-looking installation.

You'll find Mini-Panel at auto supply stores and the automotive section of leading retail stores.

STEWART-WARNER ESTABLISHED 1947

We'll send name and address of your nearest dealer.
CALL TOLL-FREE 800-621-5199. IN ILLINOIS 800-972-5855.

*Mini-Panel fits U.S. made AMC, Chrysler, Ford and GM vehicles; adapters are available for most imports.

Elmer's Carpenter's Wood Glue. How the pros make it look easy.



Grabs instantly.



Aligns easily.



Even do-it-yourselfers can do it like pros with Elmer's® Carpenter's Wood Glue.

It's specially made to penetrate both hard and soft woods, grabs instantly, yet you can still realign the joint before it sets. After drying, it forms a heat and water resistant bond that's stronger than the wood itself.

Elmer's Carpenter's Wood Glue is also sandable, paintable and resistant to gumming. What's more, its solvent-free, non-toxic* formula quickly washes off hands and wood with water.

Now what could be easier than that?

For plans of the Elmer's Dollhouse, please send \$2.00 in check or money order (no cash or stamps) to: Elmer's Dollhouse, P.O. Box 157, Hilliard, OH 43026. Allow up to 6 weeks for delivery.

*As defined by Federal Hazardous Substances Act

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Elmer's. When results count.

National Highway Traffic Safety Administration at 800-424-9393.

For the good of society

My 1980 Chevrolet Citation (four-cylinder engine and manual transmission) starts instantly and runs well for about 30 seconds. Then it all but refuses to move, unless I tie a string to the choke activator rod and pull the choke open. The dealer says everything is okay. "These new cars just have to warm up before they can be driven," he says. He suggests I start the engine and go back in the house for another cup of coffee to let the engine warm up. Poor advice in a fuel-conscious society, don't you think?—T.M. Crocker, Colorado Springs, Colo.

Awful advice, in any society, T.M. This guy is shirking his responsibility. The engine is obviously getting too much choke. The cause could be an improperly adjusted electric choke bimetal or an improperly adjusted choke. Although this is supposedly a nonadjustable choke, don't believe it. GM has issued several service letters to dealers, telling how to make this adjustment in cases such as yours. But it is tricky and takes work, which is maybe why the dealer gave you that advice.

If your dealer doesn't cooperate, try another GM facility. You're not locked in to this particular guy, although you bought a car from him. A GM spokesman told me that, in the end, if no one satisfies your complaint, you are entitled to have the carburetor replaced under the terms of your warranty. If it comes down to it, call the GM zone office.

Old(s)-timer

I have a 1956 Oldsmobile Super 88 that's a gem, except for a wrinkled left front fender. I've looked around, but can't find a replacement. Do you know where I can get a new fender?—Carl Gill, Silver Spring, Md.

Nope, but there's a good chance you'll find your fender by scanning *Hemmings Motor News*. This monthly magazine is filled with ads for old and antique cars and parts. Write Box 100, Bennington, Vt. 05201, for subscription information.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

Safety and service tips

■ If you have a 1971-78 Plymouth Voyager, Dodge Sportsman or Dodge van with power steering, Chrysler wants you to take the vehicle to a dealer so that it can be checked for a possible crack in the left frame rail—a crack that may, at some time in the future, affect the steering.

About one million vehicles are involved in the recall. Chrysler has said that it will inspect and repair any of the vehicles that are involved, if necessary, at the company's own expense.

■ A memo from Chevrolet warns that there are two different types of temperature sensors for every engine.

One type is used with an indicator light, while the other kind is used together with a temperature gauge.

They'll both fit, but if you should accidentally get the one that isn't supposed to be used, you'll either receive no gauge reading, or you'll wind up with a light that stays on all the time.

■ Ford reports in its Motorcraft Service Bulletin 5, Article 51, that any vibration and noise that occur between speeds of 40 and 55 mph in a 1979 F-150 pickup having a 3.50 rear axle may be caused by imbalance in the drive line.

The bulletin describes how you go about relieving the condition and calls for the installation of a vibration damper kit (part No. D4TZ-10110A14-A).

PM

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The symbol of imported luxury. Bottled in Canada.
Enjoy our quality in moderation.

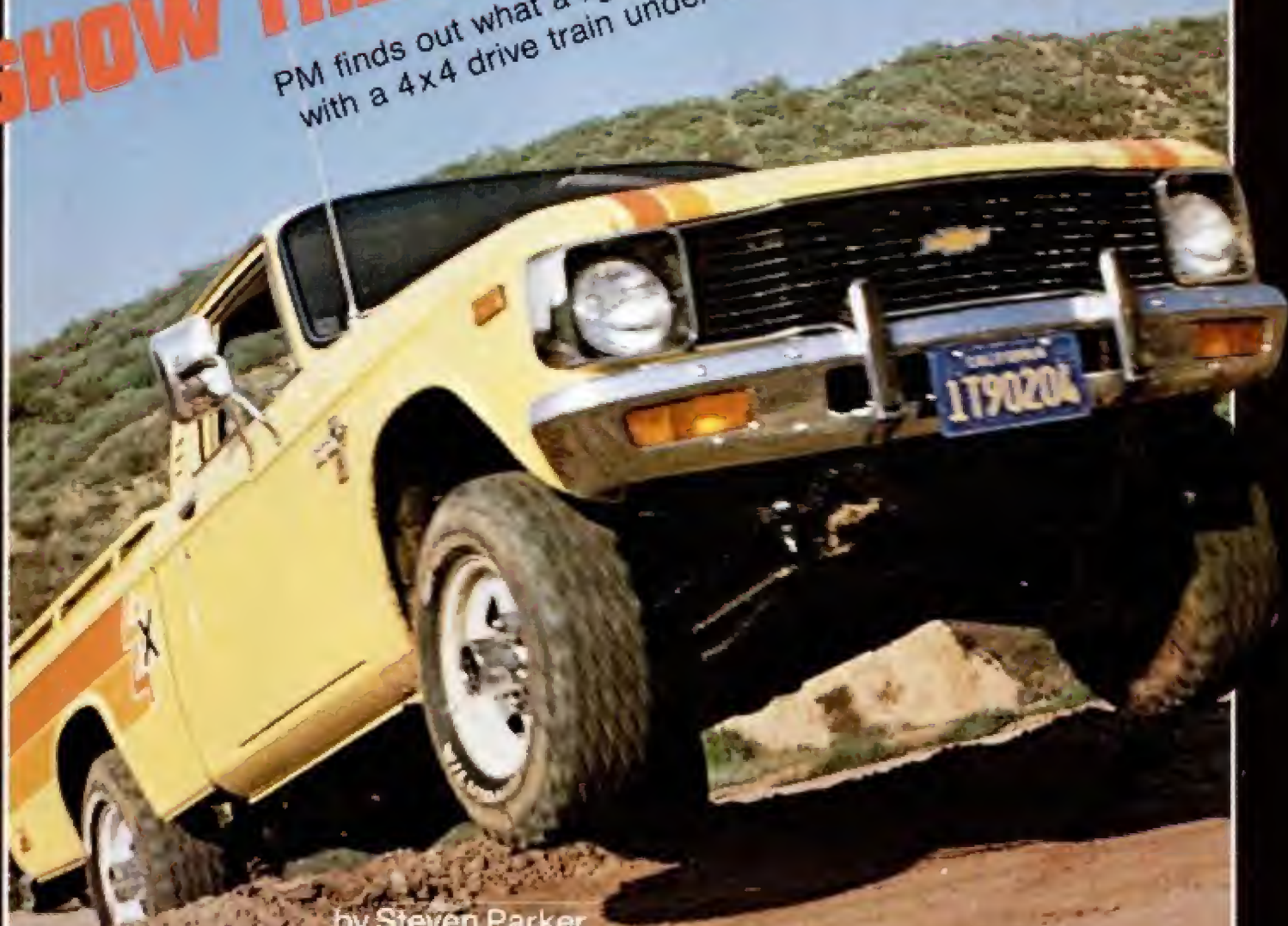
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Popular
Mechanics

FOUR NEW MINI PICKUPS

SHOW THEIR OFF-ROAD MUSCLE

PM finds out what a lightweight can do with a 4x4 drive train under the bed.



by Steven Parker

Chevy Luv, built by Suzuki, crests a hill in our off-road torture test. Luv has manually locking hubs, 7.5-in. ground clearance and a skid plate to avoid damage to the engine.

A long time ago the only ways you could go adventuring in the boondocks were to build your own dune buggy or find a surplus Army jeep and restore it. When the car companies got wise to the off-road trend they quickly came on the scene with a multitude of brawny 4x4s. While these big-engined vehicles got you as lost as you wanted to get, they consumed fuel like a NASCAR racer.

In an effort to combine fuel economy and off-road capability a new phenomenon was born: 4x4 mini pickups. These little brawlers could go anywhere the big guys went but do it a lot cheaper.

Our 4x4 off-road enduro test includes all the 4x4 mini pickups on the market. Three of them, the Subaru Brat, Toyota and Chevy Luv have been around for a while. The fourth, Datsun, is

PM photos: David Gooley

brand new and was reported on in June. (See *Bashing through Baja*, page 92).

The trucks are very similar in many respects. All are equipped with part-time four-wheel drive, all have front disc brakes and they all sport plenty of ground clearance and protection for undercarriage components.

It didn't take long for Japan to note that 40 percent of the Amer-

ican light-truck market was being equipped with *factory* four-wheel drive, not the after-market option that could cost up to \$1500 above the price of the standard truck.

Subaru was the first to catch on to the trend. Fuji Heavy Industries' BRAT (Bi-drive Recreational All-terrain Transporter) came out in the mid-'70s and set the stage for a dramatic image change for underrated Subaru. It didn't take the country by storm, but the BRAT didn't go unnoticed, either.

Toyota and Chevrolet (Isuzu) came on with their own models in 1978 at about the same time.

Just what exactly is a mini pickup? Well, for the most part they weigh in at about 2200 pounds and can carry about 1100 pounds of payload. They are quick off the line, are fuel efficient and they have started an entire industry of after-market equipment manufacturers. But, most of all, mini pickups provide maxi-fun.

All the 4x4 vehicles we tested

(Please turn to page 102)



Toyota's mini pickup (left) has the biggest engine of the lot, 2189 cc, and is also the most expensive, \$6498. The interior (below left) is also the most functional of the four pickups. It has 7.9 in. of ground clearance and its rugged construction outshone the competition.



Subaru Brat (right) is least expensive and the most fun, has two jump seats, full carpeting in the bed. Spartan interior (left) reflects low sticker price. It's closest thing to a 4x4 sports car.



Datsun's 4x4 (top right) is the newest of the four and Datsun's first entry into this market. Interior (top) is cluttered. Chevy Luv (right) is the most comfortable on pavement; interior (above) was the most accommodating.



HOW TORNADO LABS TAME GIANT TWISTERS

Scientists on several fronts are closer than ever to unraveling the mysteries inside nature's monstrous funnels.

by Franklynn Peterson
and Judi R. Kesselman

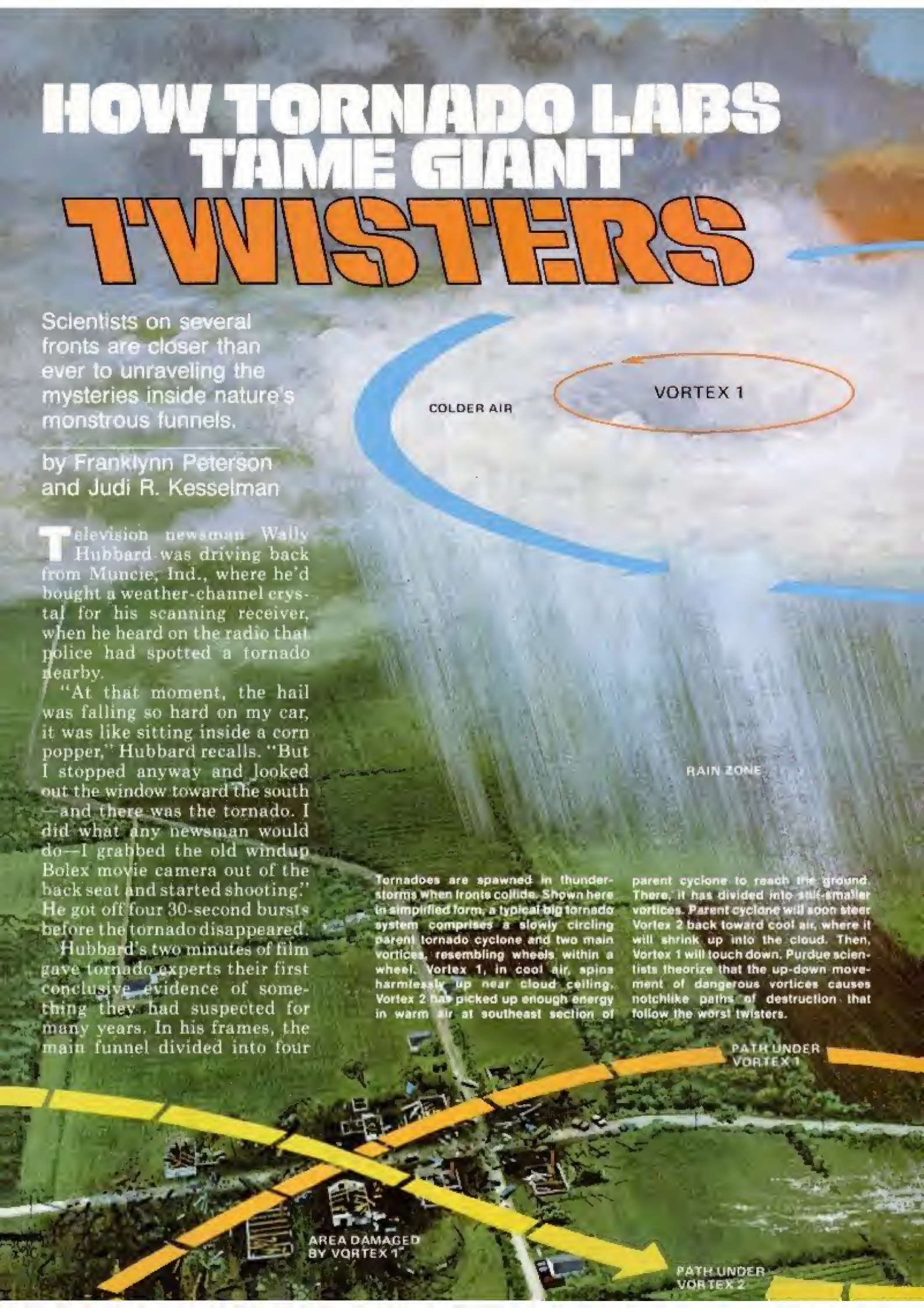
Television newsman Wally Hubbard was driving back from Muncie, Ind., where he'd bought a weather-channel crystal for his scanning receiver, when he heard on the radio that police had spotted a tornado nearby.

"At that moment, the hail was falling so hard on my car, it was like sitting inside a corn popper," Hubbard recalls. "But I stopped anyway and looked out the window toward the south—and there was the tornado. I did what any newsman would do—I grabbed the old windup Bolex movie camera out of the back seat and started shooting." He got off four 30-second bursts before the tornado disappeared.

Hubbard's two minutes of film gave tornado experts their first conclusive evidence of something they had suspected for many years. In his frames, the main funnel divided into four

Tornadoes are spawned in thunderstorms when fronts collide. Shown here in simplified form, a typical big tornado system comprises a slowly circling parent tornado cyclone and two main vortices, resembling wheels within a wheel. Vortex 1, in cool air, spins harmlessly up near cloud ceiling. Vortex 2 has picked up enough energy in warm air at southeast section of

parent cyclone to reach the ground. There, it has divided into still-smaller vortices. Parent cyclone will soon steer Vortex 2 back toward cool air, where it will shrink up into the cloud. Then, Vortex 1 will touch down. Purdue scientists theorize that the up-down movement of dangerous vortices causes notchlike paths of destruction that follow the worst twisters.





PARENT
TORNADO
CYCLONE

1/2 TO 2 MILES

VORTEX 2

WARMER AIR

40-MPH FORWARD
MOVEMENT TO
NORTHEAST

1000-1200 FT.
TO BASE
OF CLOUD

75-MPH
UPDRAFT

AREA DAMAGED
BY VORTEX 2



Two tornado funnels (above), dropping out of the same cloud, struck Nashville, Tenn., in 1974. That year, twisters devastated 10 southern and midwestern states and Ontario, killing more than 337. Single-funnel tornado (left) pulled dirt into a black cloud over a road in Stratford, Tex., in 1978. However, the resulting damage was minor.

funnels, each snaking over the land like an inverted Hydra monster.

Hubbard's confirmation six years ago that the most powerful tornadoes have more than one funnel made twisters seem more terrifying than ever. But since then, scientists have expanded research on at least four fronts to unravel the mysteries of tornadoes:

■ In an Indiana laboratory, Purdue University scientists are making

and studying miniature tornadoes to find out how to tame them.

■ U.S. weathermen in Norman, Okla., are monitoring multicolored screens displaying blotchy returns from radar signals. By reading the colors correctly, they can pinpoint tornadoes in the making.

■ Other researchers are building scale models of homes, and watching them come apart in wind tunnels. Their work suggests inexpensive

building techniques that should make homes of the future safer even in screaming winds.

■ New research also suggests how to avoid injury during a tornado. The major strategy: Seek shelter on the lowest level of a building, away from windows or walls. *Don't try to drive from a tornado's path.*

Most of the approximately 1000 tornadoes that strike the United States annually touch down in a band nicknamed "Tornado Alley." But the band is misnamed: the "Alley" is actually a broad corridor, stretching all the way from Texas to Ohio, between the Appalachians on the east to the Rockies on the west.

Weather maps and satellite photos can't begin to convey the fury of the tornado. Twisters often display a kind of bizarre personality, crumpling one house and leaving its neighbor whole, driving straw into fenceposts, spawning superstition and strange stories.

There's the story of farmer Howard C. Anderson and his cattle, for instance. Last April 7, Anderson heard reports of tornadoes in the vicinity of his Elgin, Tex., farm.

Around 5:45 p.m., he saw "the

Protection from wind—for \$85

With little extra work, material or expense, a builder can reinforce a medium-size home to withstand the force of all but the worst tornadoes.

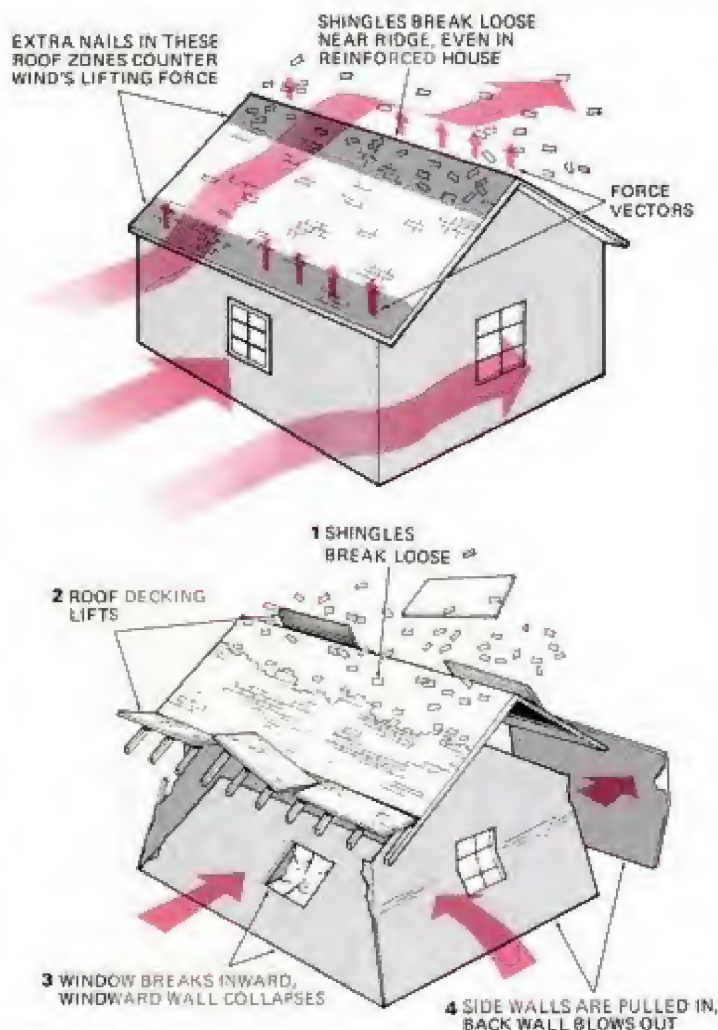
The drawing at right shows wind, typically from the southwest, flowing over house surfaces. Lifting forces are greatest near ridges and eaves (note force vectors), so the top priority is adding extra fasteners between roof decking and trusses in the darkened area on both sides of the roof. Cost for 10 pounds of 8d nails: about \$5. Better yet, add fasteners to the total roof for about \$15.

Second, strengthen roof-to-wall connections with "hurricane clips," metal rectangles with teeth punched out to bite into wood after being nailed in place. Cost of 50 or 60 of these, for installation around the roof's perimeter: about \$30.

Third, put in anchor bolts at six-foot intervals around the perimeter to strengthen wall-foundation connection. Cost: about \$40 for a 160-foot perimeter.

The lower drawing at right shows the sequence of failure in an unreinforced house, from lifting of roof decking to collapse of windward wall and side walls to blowout of back wall. But tornado research indicates builders can block this sequence, and provide protection against winds up to 180 mph, for about \$85.

For further information, write for free NOAA Technical Memo ERL NSSL-82, National Severe Storms Laboratory, Norman, Okla. 73069, or free pamphlets from the Institute for Disaster Research, Texas Tech University, Box 4089, Lubbock, Tex. 79409.—John F. Weaver, Dr. Thomas M. Murray and Roland Weaver



The other killers—hurricanes, floods, lightning

Even in good years, tornadoes kill dozens of people in the United States—the average was 50 deaths annually between the relatively mild years of 1974 and 1978. And the monstrously focused power of twisters terrifies people, even if they have never seen a funnel on their horizon. But hurricanes, floods and lightning easily rival the deadly power of tornadoes. Here's a partial listing of losses following assaults from other killer weather:

Hurricanes

Last year, Hurricane Frederic violently upheld the reputation of hurricanes as the most awesome storms to hit the United States. Spawned off the west African coast, Frederic swept across the Atlantic, past Puerto Rico and Cuba, hitting the U.S. mainland near the Alabama-Mississippi line. It ripped northward to Pennsylvania, New York and western New England, exiting from northern Maine. In its wake, Hurricane Frederic left five dead and an estimated \$2.3 billion in property damage, making it the costliest U.S. hurricane ever.

Frederic followed on the heels of another bad actor, David, a storm that generated winds up to 150 knots, making it the most intense of the season. As it moved through the Caribbean, it leveled the island of Dominica, leaving 56 dead and 60,000 persons homeless, and battered the Dominican Republic. The toll there: 1200 dead and 200,000 homeless.

Floods

In 1979, flood and flash-flood property losses reached an estimated \$4 billion, with more than 100 lives lost. In recent flood annals, this is topped only by 1972, when there were over \$4.4 billion in losses and some 550 fatalities.

April, as the poet said, is the cruelest month. After one of the wettest winters in years, soil conditions in southeast Texas last year set the stage for flash floods. There were three periods of heavy rainfall during April, according to

the National Weather Service, causing some of the worst flooding in southeast Texas since 1973. Economic losses exceeded \$500 million, and there was one fatality. In southern Texas, four lives were lost in flash floods.

The storm system moved eastward into Louisiana, Mississippi and Alabama, causing damage of nearly \$1 billion and claiming 15 lives. The rising flood toll of recent years is attributed by the National Oceanic and Atmospheric Administration to increasing urban development along rivers and in narrow canyons in mountainous areas.

Lightning

For many years, more deaths were attributed to lightning than to any other form of killer weather. One study shows that from 1940 to 1973, there was an annual average of 204 lightning fatalities.

Tornadoes accounted for 132; floods, 90, and hurricanes 54.

Since 1953, lightning deaths have been on the wane—the number now averages 100 annually—but the change may be largely statistical. Prior to '53, statistics included deaths from lightning-caused accidents—felled trees, forest and home fires, and downed power lines.

The records suggest where *not* to be in a thunderstorm: the most dangerous places are under a tree, on a golf course or on or near open water.

On the other hand, the value of being inside a metal vehicle during an electrical storm was made vividly evident in Plainview, Tex., when a pickup truck was hit by a bolt. Of four persons riding in the truck's open back, three were killed, one injured. Three others inside the cab were unhurt.—*John Pearson*



Hurricane Frederic lashed Puerto Rico, then ripped through mainland last year.

blackest cloud I've ever seen" approaching his land from the west, and took shelter in his home. After the storm had blown through, Anderson looked out toward his pasture. He was surprised to see half a dozen head of cattle on a hill and went outside to see how they were. Then:

"All of a sudden, here came five cows and calves.

"At first I didn't know whose they were," Anderson told us, "because they were caked with mud. As they came closer, I saw they were mine ...

They were making a beeline back to the pasture." None was injured.

Anderson followed their tracks eastward. There were a couple of extraordinary things about those tracks. They stretched out straight for a full two miles from the farm, through land so furrowed by wind that it looked like frozen ocean. *And the tracks were only going one way.* How did Anderson's cattle make the round trip of roughly four miles in 20 minutes, averaging 12 mph?

"My cows and calves don't run that fast," he said. "They had to be

rolled, or picked up and tiptoed through the air by the wind."

To understand the bludgeoning force behind such occurrences, Purdue scientists have scaled tornadoes down, turning twister models on and off like a fan.

In a lab on the top floor of Purdue's Geoscience Building, Professors John Snow, Ernie Agee and Chris Church started by erecting a 10-foot-wide, carousel-like aluminum frame, 2 feet high. They perched the apparatus 2 feet off the

(Please turn to page 116)

Solar troller

It had to happen. Six 1×4-foot photovoltaic panels perched on the suncatchers of this boat power its electric trolling motor. Fully loaded with six passengers, the 14½-footer is said to hum along at 3 mph.

Each panel puts out about 12 volts and 3.5 amps. Panels are wired in parallel. The boat can run on solar alone, on six lead-acid batteries, or both. The panels can also charge the batteries. Nordskog

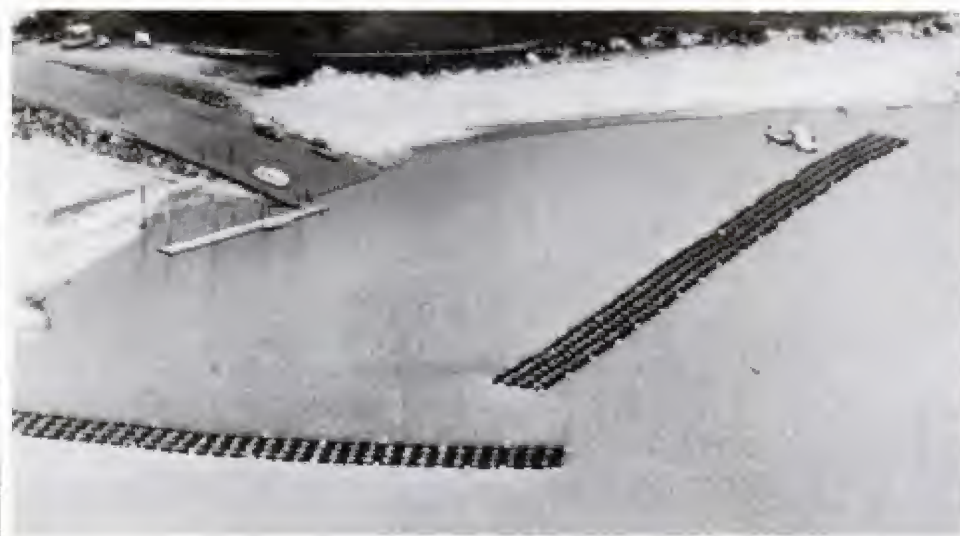
Industries of Van Nuys, Calif., put the drive system together, and Wellcraft Boats of Sarasota, Fla., built the boat. Wellcraft will soon market the boat; solar add-ons may be sold separately.



Reviving tired tires

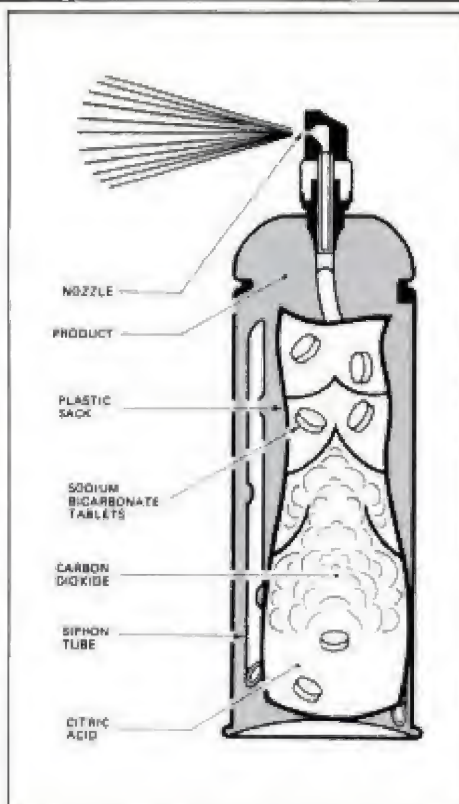
The use of old tires to form low-cost breakwaters is not new, but the two shown here are the first commercially built facilities, according to Topper Industries of Vancouver, Wash. The tires are filled with polystyrene foam via a patented

process and then linked together. The resulting, floating breakwater is said to be cheap and easy to construct, able to withstand freezing, and a snap to move. A 330-foot project for Exxon (right) took six weeks from inception to completion.



Pressure tractics

Enviro-Spray uses nonflammable carbon dioxide (CO_2) as its propellant in yet another effort to supplant fluorocarbon aerosols. Developed by Grow Group Inc., it is said to spray more of the contained product, more evenly and in any position, than its competitors, including hydrocarbon propellants. A compartmentalized plastic sack containing citric acid is prepressurized with CO_2 . When the spray button is pushed, the sack expands, breaking the compartments and allowing sodium bicarbonate pellets to drop into the citric acid, creating more CO_2 . Since the propellant never touches the product, virtually anything can be dispensed. Also, a whole can may be sterilized at temperatures up to 250°F ., unthinkable with other propellants.



Bagpipes skirl electronically

Pipes on these bagpipes are strictly for show; microprocessor circuitry enclosed in the bag generates the musical tones. Keltic Pipes were designed to make it easier to learn the bagpipes by allowing the student to concentrate on fingering techniques. Here the musician holds the electronic chanter used to send pulses to the instrument's amplifier. A speaker is in the bag, but headphones can be hooked up for practicing without bothering others. Unit runs on batteries or a.c. voltage.



An absorbing tale

If that egg is hit hard enough, even the Sorbothane surrounding it won't keep it from breaking, but the polymer will absorb up to 95 percent of the impact. Originally designed to simulate the energy absorption of human flesh, Sorbothane is said to have the dimensional stability of a solid but some of the hydraulic properties of a liquid. The British-developed substance is already being used in sports shoes and sports protection equipment, for noise and vibration damping, and for sealing applications.

Terror on wheels. by design

A multimillion-dollar theme park is only as good as its hottest thrill ride, which is why screams warm an engineer's heart.

by Robin Nelson

At Kansas City's Worlds of Fun park, the Orient Express coaster dives toward the awesome Kamikaze Kurve (opposite page).



PM picture book, 1999



Orient Express coaster's state-of-the-art claim is based mainly on a feature called the "boomerang" by the ride's designer, Arrow Development Co., and the Kamikaze Kurve by the park's thrill



marketers. Within 13 seconds the coaster enters (left photo) and leaves (right) a kidney-shaped, double-barrel-roll track section, inverting twice and blasting back out the same way it roared in.

Of the 28 people squirming into the coaster's seats and pulling the padded restraining bars down over their heads, probably two were older than 20. One was an electrical engineer working for Arrow Development Co., which had designed and built Worlds of Fun's Orient Express roller coaster. The other was me. The rest were Kansas City kids lucky enough to win a radio station call-in contest that gave them a free shot at the Midwest's hottest new ride on the day before its official opening.

The engineer, who had just finished—hopefully, I should say—the final adjustment on a photocell sensor plus microprocessor control system that would oversee safe braking and interval operation of the

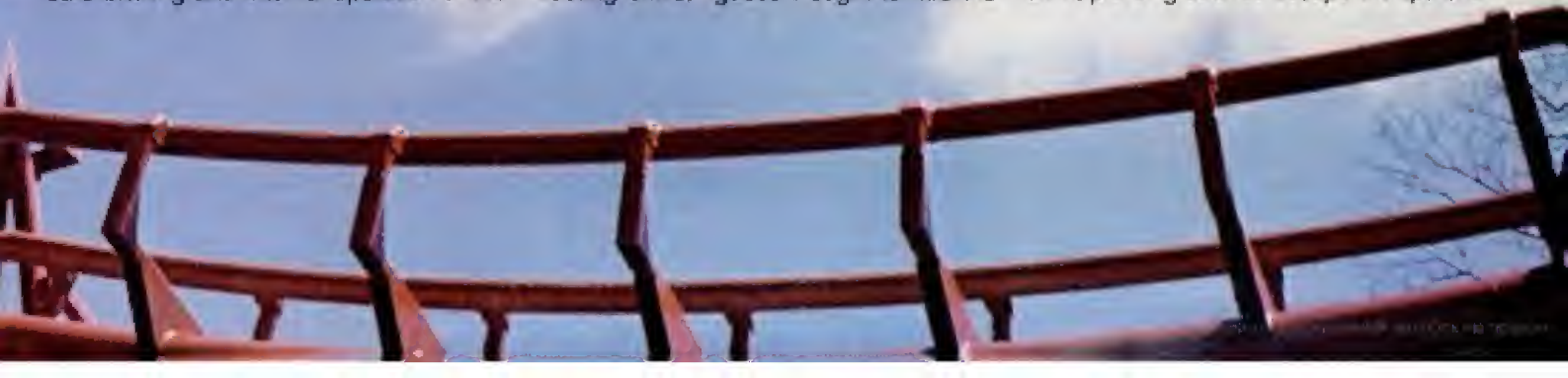


Small rollers keep coaster on the tracks.

three coaster trains, grunted as he lowered himself into the seat. It was snug on me too. "Well," he said, glancing over with an odd, fleeting smile, "guess I ought to ride the

thing once, anyway." Taking a last quick glance over the side at the insubstantial-looking polyurethane-tired wheels (photo at left), I felt the brakes let go as we slid into a short, dark tunnel from the station. As we ratcheted up toward the 117-foot-high first drop in a brisk prairie wind, I was prepared for the worst.

It was over in two and a half minutes. The first drop was a screamer, like every coaster I've ever been on, and you pulled up into and out of the first loop almost before you knew it was happening. Time for one breath and into the second interlocking loop—even tighter, if a little slower—and then, while you were congratulating yourself on making it this far without letting any shrill, piercing sounds escape the lips of a



44-year-old man wearing a London Fog trenchcoat, it happened. An unusual thrust of sideways pressure threw you smack into the Kami . . . ka . . . ze Kuuurrrve!

It is not possible to remain completely oriented through this 13-second maneuver: An initial barrel-roll shoots you out at right angles to your original course of entry; pulling up sharply, you flip again and come out heading back in the direction from which you came.

The effects of the Kurve were still with me a few seconds later as I pulled into the final braking section, following just one more sharp, but level, turn. The engineer looked relieved, and satisfied. "I think," he said reflectively, pausing to let a surge of giggles from exiting riders die out, "we've got a winner."

Since Worlds of Fun owner Lamar Hunt has invested \$4 million in the system, it had better be a winner. The park's marketing brains are banking on it, in fact, having hiked the entrance fee to slightly over \$10 for the 1980 season. Ten bucks is still considered a never-exceed figure by most people in the theme-park business, but with a draw like the Orient Express—the country's "state of the art" roller coaster—Worlds of Fun made the move with confidence. (With numerous promotional rates and discounts in effect, few customers actually pay full price anyway.)

It looks steeper than it is

There are probably 20 or more parks in the country today claiming superlative—tallest, fastest, scariest—thrill rides. Yet engineering dynamics confine most amusement rides to limits of about a 55° initial incline and top speed of under 70 mph. It may look straight down when you pitch over the top of that first drop, but 55° is what you're getting. And it doesn't take an engineering degree to figure out that while designers want drops as steep as safely possible for thrill potential, the speed built up must be killed off one way or another before the train completes a circuit.

Make the ride too long and the park can't move enough people through it per hour. Too abrupt a pull-up and you risk back and neck injuries from G-force compression. Carry too much speed into mechanical braking systems and maintenance problems, or something worse, will be the result.

The speed that's a problem to kill off is also expensive to buy; gravity gives it up only as a function of the square root of height. Adding 20 feet to a 120-foot-high coaster, for instance, would only give it about 5 mph more, or about 65 mph at 140 feet, assuming a constant 55° incline. To get to 100 mph, you'd have to build a 400-foot drop. Thus, the promotional claims of highest, fastest and the like, bandied about in theme park advertising these days, are based on such minor in-



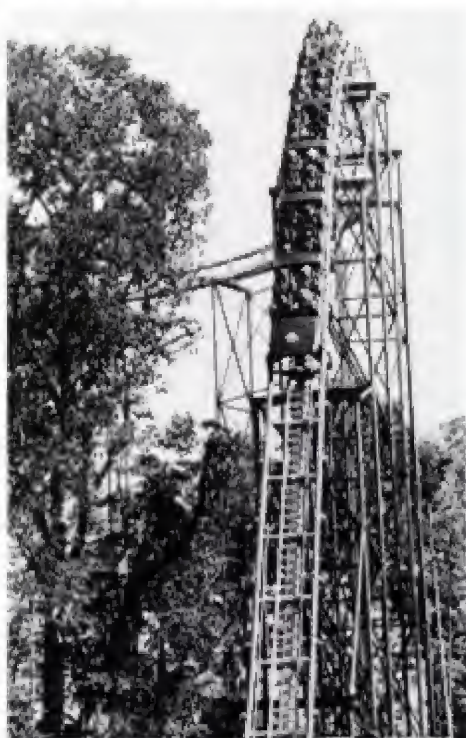
Heading into loop on the Loch Ness Monster at Busch Gardens, Williamsburg, Va.

crements that they have very little bearing on what the ride does to the pit of your stomach. With height (therefore, speed) bumping up against its practical limits, thrill ride designers have only the geometry of the track as a readily available avenue for pursuing more intentional terror on wheels.

"In the future," says design engineer Ron Toomer, "you'll probably see even more features analogous to high-performance aircraft." Toomer, who works for California's Arrow Development Co., helped conceptualize the "boomerang" feature that Worlds of Fun calls the Kamikaze Kurve (with a potential market in Japan, the designer prefers the former name).

In the past decade, the new geometry of roller coasters has provided a fertile market for both Arrow and West Germany's Schwarzkopf firm (story on

Telephoto lens gives thrill ride a "promotional" perspective; that's only a 55° drop.



opposite page). These two companies dominate the field and compete head-on for multimillion-dollar contracts. Interestingly, in working with gravity and geometry, the two competitors have evolved highly differentiated mechanical systems.

Different brakes and wheels

Take the track: Schwarzkopf tracks are bolted together with slip joints to allow for hot weather expansion. Arrow uses welded pipe-type track with no expansion joints—the system simply expands as a whole.

Wheels: Schwarzkopf uses a proprietary mixture of nylon and other materials for tires; Arrow uses polyurethane—just like roller skates. Schwarzkopf's three-bearing (one ball, two roller) system is sealed and lubricated with molybdenum disulfide; Arrow's two-roller bearing system is lubricated with ordinary crankcase oil (as weather warms, heavier oil is added to the system to keep the coaster speeds in line).

Both systems use automotive-type, metal-to-metal caliper braking systems. Arrow's single brake fin (cold-rolled steel) extends vertically underneath each car; Schwarzkopf has fins extending horizontally on each side of the car—and therefore more braking surface to grab. Arrow's brakes are activated (closed) by air pressure, relying on emergency pressurized tanks in event of compressor failure. Schwarzkopf brakes are kept inactive (open) by air pressure and then are automatically spring-closed in the event of power failure.

Says one park's ride operations manager, who has worked with both systems: "It's obvious that the European setup is more sophisticated—whether that's best depends on who is going to buy and run it."

But are they safe?

Safety questions arose earlier this year when an electronic malfunction on a Schwarzkopf-designed ride at Marriott's Great America park at Santa Clara, Calif., resulted in a fatal accident. Authorities in the field seem to indicate, however, that today's system design, including model and full-scale testing, photocell and magnetic sensors for interval control—even microprocessors—is resulting in essentially safer thrill rides than have ever been built. Yet both the cost and complexity of local maintenance have increased, and the consumer might be guided by the overall appearance of a theme park and the caliber of its employees as well as anything.

Over 100 million Americans visit theme parks each year. Fatalities on all amusement rides are averaging less than 10 per year—including ski lifts. Ironically, cable-suspended rides, the tamest around, account for far more fatalities than the rides designed to scare you to death.

FM

Anton Schwarzkopf—just a simple 'pretzel' merchant

Today's cult of individualized roller coasters, those with names like "The Scream Machine" and "Mindbender," owes more to one man than any other. He is a former cartwright named Anton Schwarzkopf, 56, who employs roughly a third of the work force of the Bavarian town of Munsterhausen (population 1500). Because of Schwarzkopf, Munsterhausen is occasionally called "the Peenemunde of thrill rides."



A. Schwarzkopf

Schwarzkopf was contentedly operating the family cart and wagon business until 1955, when he visited an amusement exposition in Munich, 50 miles away, and got the idea that he could build a better merry-go-round. In a few years, he had worked up to bumper cars, and in 1964, Schwarzkopf designed and built the first roller-coaster system made from steel instead of the usual wooden trusses and supports. Since then, Schwarzkopf has registered 60 patents in the field and has produced upwards of 55 coaster systems that have been sold in countries around the world at prices ranging up to \$4 million each.

A number of Schwarzkopf innovations not protected by patent have been adapted by other manufacturers in the field. It makes him reluctant to discuss certain aspects of his designs. He will not disclose, for example, the exact composition of his wheel material—except to say that it includes nylon and Teflon in a combination hard enough to sustain high speeds, but not so brittle that it will crack under stress.

Perfecting the loop

In 1973, he began research on one of his most important projects: the loop. "We didn't invent it," he concedes, "since there had been a roller coaster with a loop at a Russian amusement park in the late 19th century, and one built at New York's Coney Island in 1901.



But they were too small and coasters going through them were subject to as many as 12 Gs. There were many injuries."

By comparison, astronauts at liftoff pull under 5 Gs. Besides being too small, those early loops were perfectly circular and this, as Schwarzkopf found out through experimentation, is not a good shape for a coaster loop. Trying a number of mathematically correct curves, Schwarzkopf and his associates found that a spiral in which the radius of curvature decreases at a constant rate would provide excellent geometry for a safe loop.

Thus we have the modern, teardrop-shaped loop, in which a coaster can maintain a minimum of 0.6 Gs at the top, keeping riders in their seats, without exceeding 6 Gs—and only approaching that briefly—as it enters and exits.

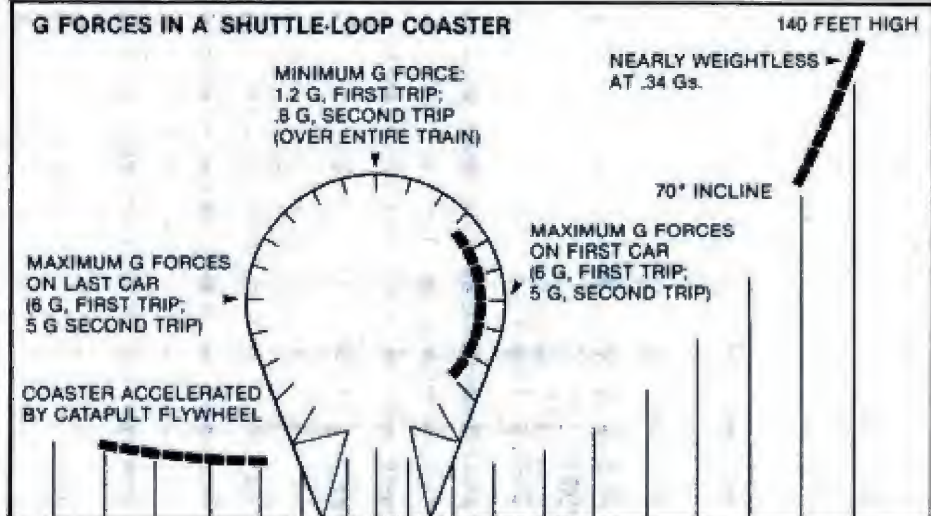
With his loop tested and proven in 1975, Schwarzkopf further developed cars, undercarriage, tracks and trusses now used every-



Simple wooden trusses supported test track at Schwarzkopf's works in Bavaria, where the teardrop-shaped loop (above) was perfected in 1975. An outgrowth was the Shuttle-Loop (below), in which counterweight or catapult gets train up to speed for forward/backward runs.



G FORCES IN A SHUTTLE-LOOP COASTER



Shuttle-Loop schematic shows the "nodes" at each side of the loop, where high-G conditions are encountered. First car of the train gets highest Gs on entry

side (right); rear car pulls highest on exit. After incline tower halts the train for the backward run, the situation is reversed. Moral: For least strain, ride mid-train.

where to support inverted thrill rides. When some American insurance underwriters questioned whether his restraining bar design would be safe under emergency circumstances, he flew them to Munsterhausen, put them on a coaster and had them braked to a stop at the top of a 70-foot loop—where they hung from the restraining bars until they got the point.

Schwarzkopf is exacting in his ideas on safety; if it were up to him, anyone who directly operates a thrill ride would have to be licensed.

For the future, Schwarzkopf envisions extending the inverted regimes on his coasters, with cars hitting 50 mph while suspended in upside-down straightaways.

"To design a coaster," he says, "you just have to think of a pretzel. And we have plenty of pretzels in Bavaria."—John Dornberg

Compact camp-cruising by kayak

The boat may be small, but your trip can be a long one. So far I've paddled about 3000 miles in my present kayak, and today's touring models make it possible to copy safely the Eskimos' mode of travel. But for the long solo passages I enjoy, I've found you can do some customizing and improve on a good thing.

A little planning can make a kayak cockpit as ship-shape as a submarine, with all essential safety and convenience gear stowed securely right at your fingertips. To plan placements aboard my 17-foot folding Klepper Aerius II kayak, I assembled the frame first without its

With a little customizing, you can turn a minicraft into a passagemaker

by E.P. Haddon

Hypalon hull-covering. In the past, I had tested arrangements for storage of gear and supplies in a Folbot and other kayaks I have owned. (My first was one I built from Dan Beard plans when I was 9 years old, just 62 years ago.) Fitting out hard-shell fiberglass

kayaks can be done in much the same way.

First, I installed a nylon pocket that holds a nylon storm suit ready for instant use. Next to it came a canteen and a quart-size plastic Gatorade bottle with sipper tube. These are attached to the inside gunwale next to a knee, and held in place with 1/2-inch nylon straps like those used on



This 71-year-old author-adventurer knows how to select and secure his gear carefully. He's looking forward to more long, solo, paddle-powered voyages.



Supplies are packed aboard for a month-long exploration of some of Lake Amistad's 850 miles of Texas and Mexico shoreline.

backpacks. On the opposite gunwale, four small tackle boxes are conveniently held in place with Velcro tabs. One drop of instant glue permanently attaches tabs on each box and matching tabs on the gunwale. No fisherman has ever had lures within such easy reach. A single Velcro tab secures a small, liquid-filled compass to the kayak floor or to the deck when traveling offshore or in foggy weather.

Because of a kayak's low center of gravity, particularly

(Please turn to page 120)



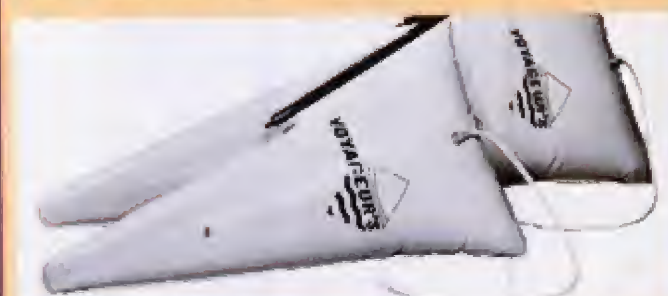
Stow canteens, foul-weather gear, anchor and fishing tackle where you can reach them easily. Uncovered kayak shows how.

New compact-cruise accessories

Mini-boats have minimum storage space for camp and cruise gear, but most have bow and stern compartments that can hold float bags with backpack-type essentials.



The Pocket Hotel, from Early Winters Equipment, needs no rain fly since it's Gore-Tex; it weighs two pounds, is \$128. From 7¼ feet, it folds down to a compact 4¼ x 15¾ inches.



Inflatable Voyageur Tour Paks, from Voyageur's Ltd., Gardner, Kan., open to store a sleeping bag, tent or supplies, and fit fore or aft in a kayak to provide extra flotation.



Adding only one extra ounce for the packer or paddler with a Coleman Peak 1 stove, the new stuff sack for the little cooker can also cushion a camera or fragile binoculars.



A bivouac sack of Gore-Tex that lets perspiration out without leaking rain in, the Early Winters Sleep Inn makes a \$69 bivy bag tent substitute to cover your sleeping bag.

New outdoor gear: Lighter



The classic look of a cedar strip-planked canoe is available for home builders in a Canoe-In-A-Box kit, complete with cedar and fiberglass, for \$645 from Old Town Canoes.

Spinoffs from space-age materials, production methods and electronics provide a bonus in sports equipment.

by Bill McKeown
OUTDOORS EDITOR

Outer space is lending its leadership in technology to the outdoors. New compounds that can resist tremendous stress and still last longer and weigh less are already being incorporated into this year's sporting goods.

Graphite, boron, magnesium and titanium are chemical and metallurgical names that are appearing on outdoor equipment and tackle. Kevlar, Kodofil, Thinsulate, PolarGuard, Teflon and Hollofil are among the made-up titles for compounds that are keeping sportsmen warmer, dryer, safer and more relaxed because they're required to use less energy to brave the elements.

"Wonder" and "miracle" products are less in evidence. We now know that "all-purpose" and "maintenance-free" boats, tackle, knives and guns are unlikely, but better-made gear will wear out more slowly and have more dependable life span. Stainless steel can eventually corrode and is harder to sharpen to a keen edge, but it provides a trade-off

(Please turn to page 123)



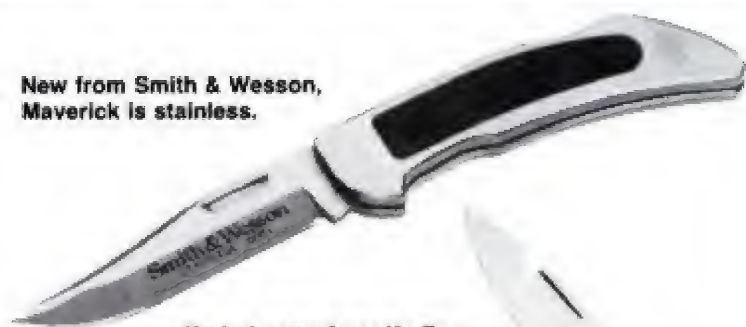
Programmed for user's metabolism, \$70 Cal-Count totals calories burned by all forms of exercise.



The \$40 Brooks Huger GT is called the first breathable but waterproof jogger's shoe by Early Winters Ltd. of Seattle. Uppers are made of Gore-Tex fabric.

and stronger than ever

New from Smith & Wesson, Maverick is stainless.



Ka-Lok, new from Ka-Bar, locks with bottom bolster.



A mini lockback is the new 2½-inch Case model.



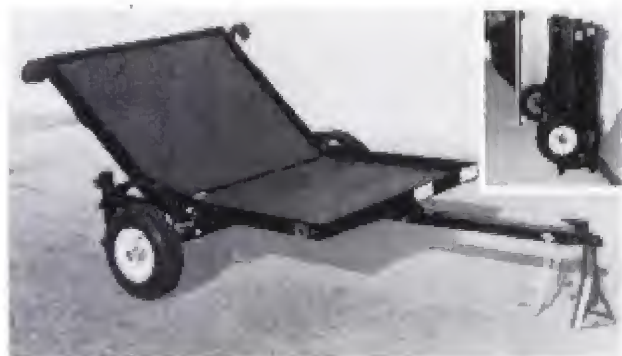
Quality knives, many with lockback and stainless steel, are newly popular: \$30 Maverick with sheath, \$29 Ka-Lok with invisible lock, \$19 mini Case.



Omniskates has combined what it calls the lightest high-top shoe, from Adidas, with roller-skate bottoms, for \$100.



Fastest retrieve of any level-wind is Daiwa's claim for their Procaster SM-2A reel (\$65), which has a 5.2:1 gear ratio.



For towing behind a compact and then stowing folded in a 20-inch space, \$459 Tow 'N Stow is by Trail-R-Craft.



Kevlar aramid fiber and a new vacuum-bag molding process make possible this 18-foot, 35-pound canoe, available from We-no-nah.



This crossbow with a telescopic sight is available as a rifle or pistol from B.&P. Barnett Ltd. of Lambeth, Ont.



A new pole system for the Coleman 6-pound Backpack Classic two-person tent now makes it free-standing without use of pegs.

Remember when buying a Pontiac meant you were on your way up—up toward a Buick or maybe even a Cadillac?

Pontiac was General Motors' stepping stone back then. You moved from a Ford or Chevrolet to Pontiac. Later, if your boat really came in, you traded your Pontiac and kept climbing.

No more. No longer is Pontiac just a stepping stone. In this age of fairly shallow owner loyalties—an age when Americans switch freely between domestics and imports and check prices and EPA ratings long before they look at name-



For the first time in many years, Bonneville and Catalina share the same front end.

plates—Pontiac bucks the trend by spawning the fiercest sort of owner loyalty. Pontiac owners, it seems, would rather stick than switch.

Actually it's no big mystery. Pontiac became an image car during the 1960s and

PM OWNERS REPORT PONTIAC BONNEVILLE

'70s, first on the track and later by engineering such hits as the GTO, Trans Am, Grand Am and Grand Prix. What these cars have given Pontiac is an identity—an identity that's a lot sharper than most.

Nearly half the Bonneville owners we surveyed listed *past experience* with Pontiacs as their main reason for buying. In other words, they'd owned them before and had come back for more. That's very unusual in this day and age.

In addition, 91.7 percent of our respondents said they'd choose another Pontiac next time they buy. Again, that's an extremely high percentage, and shows owner loyalty right up there with cars like the Cadillac Seville. And the fact that such loyalty comes from owners of full-

size Bonnevilles makes this statistic that much more amazing.

People kept telling us about all those previous great Pontiacs they'd owned and driven. "This is my ninth since 1955," said a New Mexico teacher, "and all from the same dealer."

A Texas rancher beamed that he'd driven nothing but Pontiacs since 1941, and a Kentucky horseman confessed that, "I've owned Pontiacs all my life." These aren't isolated comments either—they're typical.

Fuel mileage became a big point of discussion. About 71 percent of the Bonneville owners we surveyed had opted for the medium-size 301 (4.9-liter) V8. Surprisingly, the 231 V6, the 301 V8 and the 350 gasoline V8 all delivered very nearly the same mpg. Highway mileage differed by only 0.1 mph between Pontiac's small-



Roomy interior offers split front seat, rally gauge cluster and walnut dash panel.

BY MICHAEL LAMM WEST COAST EDITOR

Loyal Pontiac owners love the Bonneville, but the transmission could be improved

Four-door models have a restyled upper window area.

Hoodline is lowered for better aerodynamics.

Improved ball joints reduce friction and rolling resistance.

Automatic transmission hunts for gears between 40 and 50 mph.



est engine and the largest one offered.

This fact left owners of the V6 miffed and those who'd chosen the big 350 gasoline V8 elated. It shows, though, that small engines in big cars don't always equal economy.

The V6, naturally, must work harder to move the car and thus the driver often tromps the accelerator just to keep up with traffic. The big V8, on the other hand, has no trouble keeping up and loafs at quarter throttle on the highway.

About 10 percent of our respondents chose the 350-cu.-in. diesel V8. This engine, new for Pontiac this year, averaged seven to eight mpg more in both city and open-road driving than any of its gasoline-fueled peers. The Olds-supplied diesel V8, by the way, is the same powerplant available in Cadillacs, Oldsmobiles, Chevrolets and General Motors pickups. In the Bonneville, our survey showed the diesel V8 logging 22.8 mph in town and 28.6 on the highway.

Pontiac owners gave the Bonneville an overall workmanship rating identical to the Cadillac Seville's. In both cars, 74.2 percent of our respondents rated workmanship good to excellent.

Commenting on workmanship, a South Carolina textile manufacturer observed, "It's excellent. I haven't even seen a loose string end on the upholstery."

An Ohio steam-plant operator: "This car was a special order, and the factory

made a fine machine for my money."

A Minnesota plater: "It's the best American car made. To beat it you'd have to move up to a Mercedes or Porsche."

And a New York elevator manufacturer: "Excellent workmanship. I've had no quality problems at all."

When we asked Bonneville owners for suggested changes or improvements, 20.1 percent said "none." The loudest suggestion came from V6 owners, who told us they'd like better gas mileage.

A number of owners also felt that the lockup torque converter inside the automatic transmission could do with some improvement. This feature, new for 1980



The 301-cu.-in. V8 is the most popular engine option. It produces 15/19 mpg.

in several GM cars, locks up direct drive in high range so there's no hydraulic slippage—a good idea because it saves fuel. However, the lockup mechanism cuts in

(Please turn to page 132)

Backstage with the Bonneville

General Motors downsized its B-bodied cars for 1977, including Pontiac's big Bonneville and Catalina. That year's 700-pound weight loss netted an across-the-board gain of three mpg.

For 1980, Pontiac has managed to shave another 150 pounds from its full-sized cars through the use of lighter materials like an aluminum hood and tape-drive window lifts.

Less weight, coupled with a new lockup torque converter, high-pressure radial tires, aerodynamic fixes, plus the new-for-'80 V6 and diesel V8 all combine to add another two to three mpg to the line.

The Bonneville coupe's roofline is new this year. All of the big Pontiacs, including the Catalina, share coupe, four-door and wagon body styles with the full-size Chevrolet, Olds and Buick.

The Bonneville's standard engine is a Buick-supplied 231 (3.8 liter) V6, and the Brougham lists a 4.3 (265) V8 as standard. California buyers, however, are limited to the 350 gas or diesel V8s.

The most popular engine in our survey turned out to be Pontiac's own 301 V8.

All Bonneville's come with power steering, power front disc brakes, automatic transmission and high-pressure, steel-belted radial tires.

The top-line Brougham's repertory of standard equipment includes power windows, as well as extra trim and insulation.

A NATIONWIDE SURVEY BASED ON 1,394,393 OWNER-DRIVEN MILES

Current model is 100 lbs. lighter than the older one.

Although the rear overhang was shortened, available trunk space was increased by 1 cu. ft. Rear seat comfort was rated excellent by most Bonneville owners and 91.1 percent would buy another one.



Trunk is 21 cu. ft., 1 cu. ft. bigger than the '79 model.

High-pressure tires improve fuel economy.

A computer that can talk

"What did you say?" The Texas Instruments TI-99/4 computer should get a rise out of your friends when you demonstrate its talking ability. You can have it say over a hundred preprogrammed words.



NEW COMPUTERS CAN TALK, CONTROL YOUR HOUSE AND SING

Texas Instruments' TI-99/4, Ohio Scientific's C4P MF and the Atari 800 are three brand-new personal computers with exciting features. Here's how they compare.

by Neil Shapiro
ELECTRONICS EDITOR

Three new state-of-the-art personal computers offer some exciting and innovative features. Ohio Scientific's C4P MF (at \$1795), Texas Instruments' TI-99/4 (\$1095) and the Atari 800 (\$1000) are available now. We took a look at all three: Here's how they compare.

The basics and Basic

Nowadays it seems as if you can't market a new computer unless it offers a full-color display. All three of these machines offer full 16-color capability. If they will be used for games/recreation, then this is a must. Business uses of color are certainly possible, but more optional.

The three computers, as do most

personal computers, speak Basic. Because this English-style language is now considered a *de facto* standard, there is a good deal of software already written in it. If you want a program to automate something such as a checking account, it is likely you can find a program in a book, and you will just have to type it in.

Speak to me

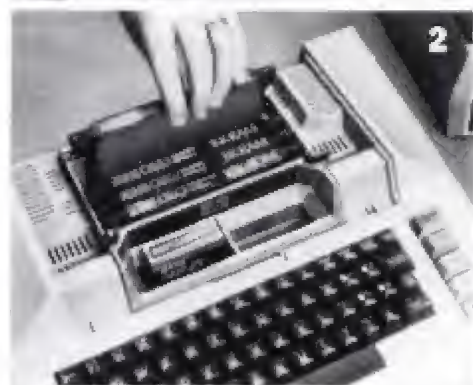
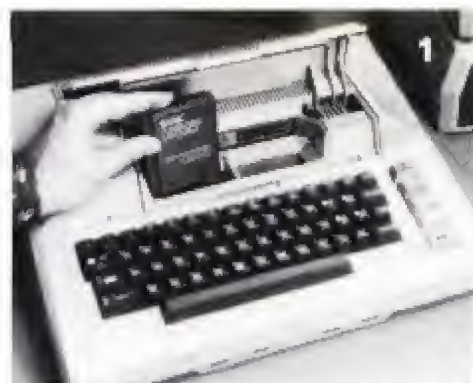
Texas Instruments' TI-99/4 offers an optional voice. The electronics involved are based on the same technology that produced the popular "Speak and Spell" line of toys from Texas Instruments.

The speech editor program is con-

tained in a plug-in cartridge (more on that system later) that holds both the vocabulary and the electronics to interface it to the computer. The unit we saw had a vocabulary of over a hundred words.

The computer can be made to talk in two ways. The simplest method is to just type in the words onto the screen, then hit the ENTER key. Harder, but more versatile, is to program the computer to use the electronic voice as a subroutine in a larger program. Then, if you program an unbeatable tick-tack-toe opponent, you will be able to have it say, in well-modulated, gleeful computer tones, "I win again!"

Ohio Scientific's C4P MF offers



Great color and smooth sound

We were truly impressed by some of the features of the Atari 800 (above and left). Programs and languages can be easily changed by plugging them in (1). Expanding this computer's memory couldn't be simpler. Memory is available on plug-in cartridge cards (2) that make installation a one-minute snap. The chips inside the memory cartridges (3) can extend the Atari 800's memory to 48,000 bytes. The Atari 800 is shown above with its matching printer and floppy disc drive. Both attach as plug-ins and can be learned in less than half an hour.

the most interesting home control features we have yet seen built into a computer, rather than offered as add-ons by secondary manufacturers. They use the popular BSR home control system, but controlled by the computer.

The automated house

The BSR system (which you can buy just to use without any computer at all) controls up to 16 lights and appliances in your home. There is a small control box with 16 buttons for each controlled light or appliance, as well as buttons for ON and OFF, DIM, ALL ON and ALL OFF.

A unit to be controlled plugs into a special remote outlet, which in turn plugs into an a.c. wall socket. (There are also special wall switches available that may be remotely controlled.) These remotes and the main control box are in constant communication over the a.c. wiring of the house through pulsed signals.

The BSR system by itself is marketed for manual control. By pressing the buttons, you can turn your lights and appliances on and off as you want, from one centralized loca-

(Please turn to page 106.)

Control everything in your home

Ohio Scientific's C4P MF, shown with matching disc drive, features amazing system. It can control 16 lights and appliances in your home. Program the appliance schedule to your needs. Back of the machine (below) shows some of the connections for accessories.



Styling does sell cars. If these Owners Reports prove one thing, it's that auto stylists—not engineers—make cars move.

America's economy owes more to the stylist than to any other single element in the automotive sales chain. Again and again, when we ask owners the main reason they choose this or that car, the answer comes back, "Styling."

That's as true for the "economini" as for the "luxocruiser." Styling makes millions of dollars move through our economy year after year after year.

The 1980 Lincoln Continental Mark VI makes a case in point. Nearly half the 1000 owners we queried listed *styling* as their No. 1 reason for buying. And styling also proved the prime motivator for choosing the Mark V in 1977, the Mark IV

PM
OWNERS
REPORT:
**LINCOLN
CONTINENTAL
MARK VI**

in 1972, and the Mark III in 1968.

"I feel Lincoln did an outstanding job of downsizing the Continental and Mark VI for 1980," commented a New York electronics engineer, "while still keeping the classic look that has prevailed over the past decade. The stylists deserve a big round of applause."

Brand loyalty ranked second as a reason for purchase. A Florida retiree told us, "I've owned Marks in the past and liked them all. I think this four-door Mark VI is the best-looking, best-made car on the market."

And yet many owners had their own, very special reasons for choosing the Lincoln. "I found the Cadillac Eldorado too

small," noted a New York gas-station owner.

"Lincoln finally came through with a four-door Mark," smiled a Texas restaurateur. "I transport a Little League baseball team and desire a large, safe car."

"I bought mine as an anniversary gift for my wife," confided an Ohio carpenter.

An Illinois construction-company president: "I wrecked my previous Town Coupe, which was all right because I wanted a smaller Lincoln with better mileage."



The cockpit features first-rate comfort and some space-age electronic instruments.

A preschool director from Illinois told us, "My husband is a truck driver and wants to have a nice-riding car when he's home. Also, we feel the Lincoln's safety margin is much better."



Unique trunk styling is just part of the enduring design that the Mark owners love.

BY MICHAEL LAMM WEST COAST EDITOR

Owners like the styling and comfort, but transmission and electronics need debugging



Keyless entry system is standard on Signature edition.

The 1980 Mark weighs 924 lbs. less than last year's.

The four-door's wheelbase is 3 inches longer than the two-door's.

When we asked owners what they like about their Mark VIs, now that they've had ample opportunity to live with them, the responses they offered included the following.

"The feeling of built-in quality and Ford's all-out attempt to build a fine car," said an Ohio cafe owner. "What I really appreciate is the genuine feel for a first-class auto."

"Very comfortable, tracks well on the road, good visibility, roomy, large trunk"—California housewife.

"I especially like the keyless entry, the digital instruments and computerized dash, appearance, roadability, comfort, and appointments"—California school administrator.

A Michigan company president: "I like the better gas mileage this new car gives me. It's lighter but still feels and rides like a heavy car, and it has a sharp and attractive body design."

A Texas salesman: "I appreciate the new 351-cu.-in. V8 and the great push-button door locks. The trip computer is excellent for trips. It's interesting and informative and, to me, now irreplaceable. I love it!"

Most Mark VI owners echoed this delight with the trip computer, but a few were miffed by its inaccuracy. A Texas geophysical explorer lamented, "The otherwise excellent onboard computer suffers from the same inaccuracy as the old gas

gauge. I can average over 20 mpg on a trip, and this car has a 20-gallon fuel tank; yet at half full, the computer tells me '125 miles to empty.' The average distance per gallon is far too conservative. I wish Lincoln would concentrate on accurate data and quit worrying about the ninny who will run out of gas without a 2- to 3-gallon reserve."

And a retired optical technician from New York brings up an associated point. "I wish they'd simplify the electronic instrument panel. It's rather confusing to

(Please turn to page 126.)



Hangar-like trunk of the Mark has ample storage for even the chronic overpackers.

1980 Lincolns in a nutshell

Last year's Mark V coupe weighed 924 pounds more than the 1980 Mark VI. And the '80 Lincoln's standard engine has been downsized, too, by nearly two liters.

Instead of the 7.0-liter (400-cu.-in.) V8, today's Lincolns come with the fuel-injected 5.0-liter (302-cu.-in.) V8 as standard equipment and with the 5.8-liter (351-cu.-in.) variable-venturi-carbureted V8 available as an option.

The 1980 Lincolns come in three basic series: Continental, Mark VI and Signature. All of them are built on the same coupe or four-door-sedan body structures; the sedan's wheelbase is currently 3 in. longer than the coupe's.

You can recognize the Mark VI by its hidden headlamps and the oval opera windows. Inside, the Mark VI also lists a digital electronic instrument panel and trip computer among its super-extensive standard equipment.

And, in the top-line Signature series, even the keyless pushbutton entry comes standard.

The Signature is recognizable by its metallic maroon or silver paint and added brightwork. It sells for upward of \$20,000, while the Mark VI stickers out around \$16,000 and the Continental at about \$13,000.

The Mark VI offers four designer models within the series. These are by Bill Blass, Cartier, Givenchy and Emilio Pucci. The designer models cost \$1800 to \$2100 more than the regular Marks.

A NATIONWIDE SURVEY BASED ON 1,156,952 OWNER-DRIVEN MILES

Distinctive grille and hidden headlights have become part of the Mark mystique. That look is still the major selling point of the car. Interior options like the sliding moonroof can take this luxury one step further—into opulence.

Dash-mounted trip computer is inaccurate, owners complain.

The 400-cu.-in. V8 is no longer available. Standard is 302-cu.-in. V8.



Many owners complained of underhood electrical problems.

Automatic overdrive transmission was criticized for hunting for gears at 35 mph.

Taking pictures under water—that's strictly for Jacques Cousteau and his high-tech pals, right? Not any more. Two new cameras, one in the popular 110 film format and one a Super-8 movie camera, can be taken by a casual swimmer into the water, onto the beach or out in the rain. Better still, they won't plunge your bank account below sea level.

Minolta's Weathermatic-A, with its bright yellow plastic body, is the first 110-cartridge camera made to survive beneath the waves. It's designed to function to a depth of 15 feet and features a built-in electronic flash. Its Super-8 soul mate, the Eumig Nautica, sports a zoom lens, close-up and single-frame shooting, built-in depth indicator and a wide-angle attachment. The Nautica is designed to work down to a depth of 115 feet, also a first. Both cameras have built-in light meters; the Nautica's exposure control is fully automatic, while the Weathermatic's is semi-automatic with three settings.

Before now, the only underwater camera accessible to most consumers was Nikon's

Freshly-dunked Eumig Nautica (right) and Minolta Weathermatic-A (below right) are unaffected by submersion. Both depend on O-ring seal to stay watertight. Nautica is shown with orange sportsfinder for underwater use. Nikon's venerable Nikonos (below) comes up for air.

Cameras for

Two new underwater cameras shoot where others fear to tread.

by Tom Sahagian

PM photos: Frank Lusk



the deep



Make your own home-movie version of *Twenty Thousand Leagues Under the Sea*: camera technique takes a little practice. The lens cannot be zoomed underwater.



venerable (and venerated) Nikonos. Only trouble was, features most people would insist on in their only camera (like a built-in light meter) were extra, and it cost too much (\$527 list) to buy in addition to a regular camera.

Not so with the Minolta and

Eumig. Each can be used in place of a standard camera without giving up a lot in performance. Not only can they both survive below sea level, but, perhaps more important, they can function in rain, snow, dust, dirt and places

(Please turn to page 127)

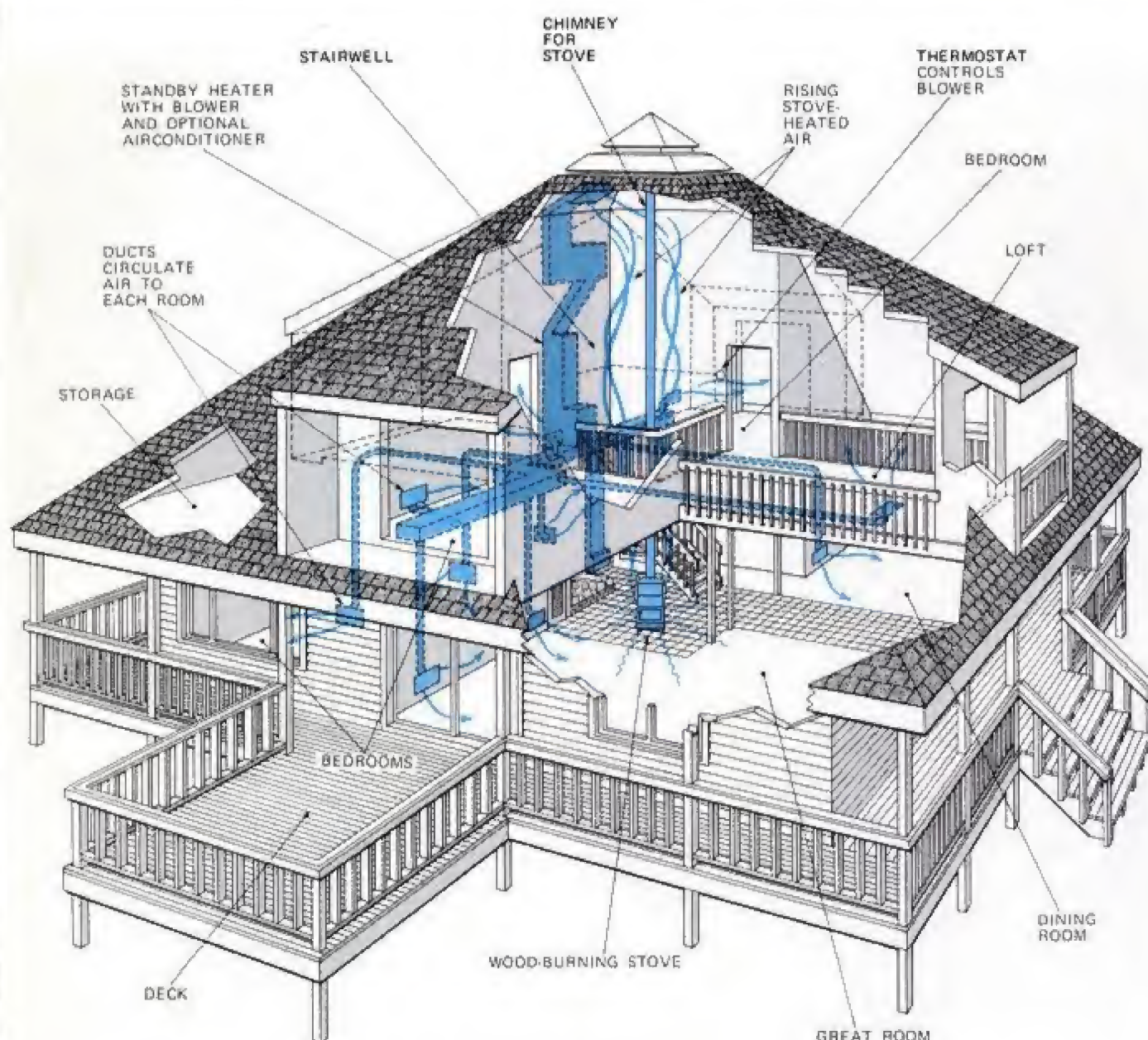
A home designed to be heated by one stove

And in summer, it creates a cool flow of air.

by John Gaynor

This remarkable, factory-built house is one of those rare examples of form logically following function—one of the primary functions of a home being to protect inhabitants from temperature extremes at a reasonable cost. Dubbed the Støvehaus by its manufacturer, it incorporates an airtight wood stove with a central heat-distribution system, thereby making the most of the stove. It allows the interior to be naturally air-cooled during summer.

The house is square to allow even radiation of stove heat which is collected and distributed to all areas—and to minimize the exterior area exposed to the weather. Hence, heat loss (gain in the summer) is minimized. The square format also econ-



CUTAWAY VIEW OF STØVEHAUS
(ARROWS SHOW HOW HEAT IS DISTRIBUTED)



Air, warmed by stove, rises via stairwell and then is recirculated throughout house.



Thermostat in loft area activates the blower when temperature reaches a preset limit.



The 14x21-ft. great room provides a comfortable focus for your family activities.

omizes materials and manpower.

The square is topped by a pyramid-shaped roof that creates a large volume to draw hot air away from the living areas. The specially made metal roof cap allows roof ventilation, as well as venting of the stove flue gases. Dormers, with door openings that extend the upstairs loft areas during mild weather, act as large natural vents.

In the center of all this is an airtight wood stove. The stairwell, next to the stove, allows natural convection of the warmed air to the loft. A duct and blower system "catches" the rising warm air and recirculates it to every room. A standby furnace (oil, gas or electric) uses the same blower and distribution ducts to heat the house when the stove is not in use. It's located in a large upstairs closet. An airconditioner, for summertime cooling, can also be added.

For a quick tour of the house, start at the entrance foyer. To each side are two "public" rooms, the great room for family activities and entertaining and the dining room. Both have cathedral ceilings. The private side of the lower level includes the kitchen, a breakfast room and the master bedroom with a full bath, accessible from either the hall or the bedroom. The upstairs contains two bedrooms with private balconies and another bathroom.

The cost of this panelized house is about \$22,000, excluding land, foundation, mechanical, electrical and plumbing systems, interior finishing and roofing. For further information, write to Mayhill Homes Corp., PM Box 1778, Gainesville, Ga. 30503. **PM**



Roof overhang shelters veranda and shades windows and doors from hot summer sun.



Low dividers separate the entrance hall from the great room and help prevent air drafts.

Architect: John Odgaard; manufacturer: Mayhill Homes Corp.; technical artist: Carl DeGroot; PM photos: E. Alan McGee. Note: The Steinhilber logo and plans are copyrighted and all rights are reserved by the manufacturer.

WEEKEND WORKSHOP: 4 projects with



1

Scandinavian flair

For many of us, warm weather turns our lifestyles inside out. From late spring to early fall, the focus is on family cookouts, swimming pools, gardening and garden parties. The four simple projects shown on these pages will add a little more charm to your back-yard living.

All of the designs are easy and inexpensive to build. No difficult joinery is involved—only careful bores and square cuts. For those projects that will receive sustained exposure to the weather, or will be in constant contact with soil, choose a naturally decay-resistant wood, such as cedar or redwood. Although pressure-treated wood is not as good-looking initially (unless you paint or stain), it's also a good choice. Note that pressure-treated nominal 1-in. stock is not readily available at many lumber yards. *Plans and how-to instructions begin on the next page.*

1. A dowel "wall" makes this planter ideal for espalier or climbing vegetables and vines. Unit is also a privacy screen.

2. An easy-to-make, airy and suspended planter is created using $\frac{3}{4}$ -in. strips of wood and dowels.

3. Standing planter for deck or patio is large enough for holding four to nine of your potted favorites.

4. Bottle rack keeps beverages handy and can be used with a barbecue bench, such as the one made of cement blocks, below.



1 Trellis planter for vines

Your peas, cukes or beans will love this portable trellis. It holds about 8 in. of soil and gravel (layered at the bottom for proper drainage).

To build it, cut all parts to the dimensions provided in materials list. Then carefully lay out, centerpunch and bore dowel holes in trellis top and bottom (C).

Ideally, the holes should be bored with a drill press or drill accessory designed for drilling perpendicular to the surface. A true hole can also be bored by visually aligning the drill-bit shank with the blade of a small try square held butt end against the workpiece.

Cut notches for the posts in the planter bottom (H) and you are ready for assembly. If you intend to stain or paint your planter, do it now. Use a protective stain with a linseed-oil base. These are available in transparent or opaque colors. If you want a natural look, use a clear preserving stain. Do not use a poly-

urethane-based coating, since clinging vines, such as peas, need a slightly roughened surface that they can cling to.

Start assembling by nailing cleats to sides (D) and ends (E) as required. Then nail the sides and ends to the posts (A and B). Fit in the bottom (H) and make certain you bore at least eight evenly spaced drain holes into it.

Next, nail the trellis bottom pieces (C) to the inside of the box as shown in the plans. Insert the dowels in the predrilled holes. Finally, align tops of dowels with holes in the trellis top (C), insert the dowels, and then nail the last C piece into place between the posts (B).

MATERIALS LIST—TRELLIS PLANTER

Key	No.	Size and description (use)
A	2	1½ x 1½ x 14" redwood (front leg)
B	2	1½ x 1½ x 48" redwood (rear leg)
C	2	1½ x 1½ x 27½" redwood (crosspiece)
D	4	¾ x 5½ x 32" redwood (front and back)
E	4	¾ x 5½ x 14½" redwood (sides)
F	2	¾ x 1½ x 27½" redwood (front and back cleats)
G	2	¾ x 1½ x 11½" redwood (side cleat)
H	1	½ x 14½ x 30½" exterior plywood (bottom)
I	6	¾"-dia. x 34" dowels
J		6d casing nails (as reqd.)
K		10d casing nails (as reqd.)
L		No. 10 x 1¼" fr. screws (as reqd.)

2 Hanging cage planter

This interesting planter is well suited to a garden or porch, but can be hung inside as well.

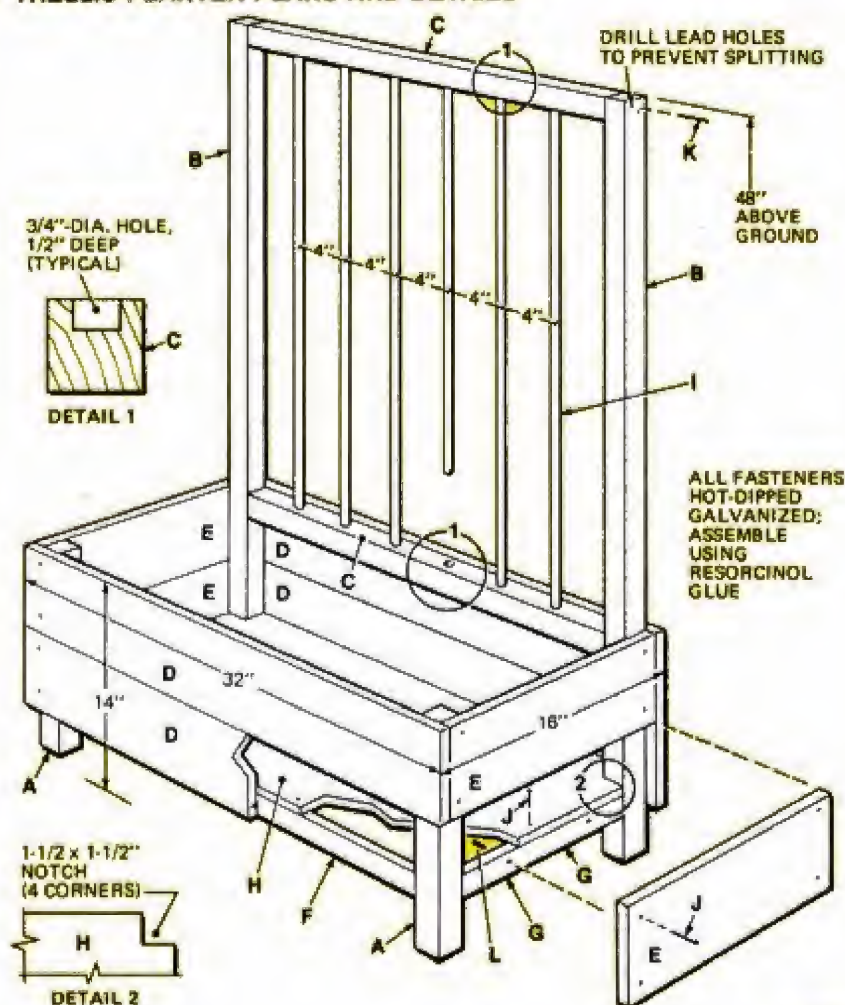
To build it, rip ¾-in.-wide strips from nominal 1-in. stock and cut to lengths given in the materials list for A and B. Then cut the side and bottom dowels (C and D) to their respective lengths. Note that the bottom dowels of the planter are ¼ in. longer than the side dowels.

Bore holes for leather thongs in top of uprights A as shown. Think in terms of panels for the assembly. Start by gluing dowels into two pairs of uprights A to form two panels with 10 side dowels left over. Then glue the bottom dowels between pieces B. Use resorcinol glue if the planter is to be hung outside and exposed to all kinds of weather.

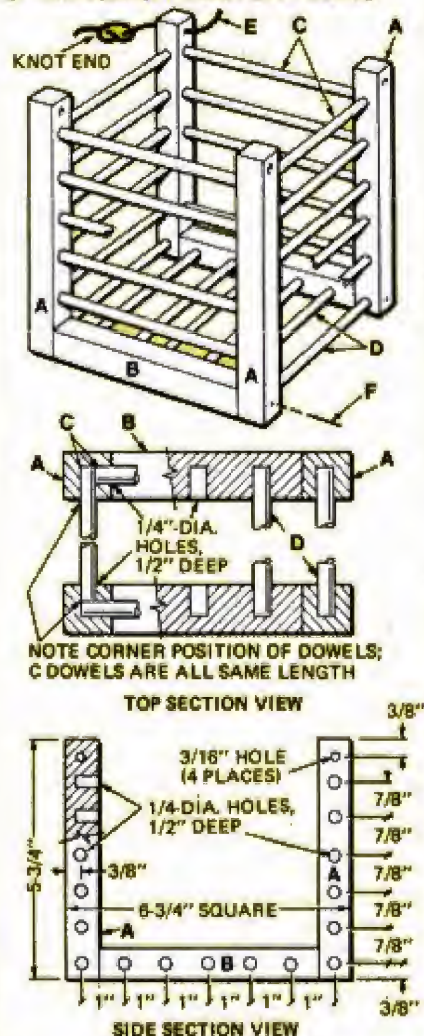
When the glue is dry on the three panels, apply glue to the remaining dowels and assemble the three panels by nailing uprights A to bottom pieces.

Attach the leather thongs by

1. TRELLIS-PLANTER PLANS AND DETAILS



2. HANGING-PLANTER PLANS



threading through the predrilled holes and knotting the ends.

MATERIALS LIST—HANGING PLANTER

Key	No.	Size and description (use)
A	4	$\frac{1}{2}$ x $\frac{1}{2}$ x $5\frac{1}{2}$ " pine or redwood (corner posts)
B	2	$\frac{3}{4}$ x $\frac{1}{2}$ x $5\frac{1}{2}$ " pine or redwood (bottom rails)
C	20	$\frac{1}{4}$ "-dia. x 6" dowels (side)
D	7	$\frac{1}{4}$ "-dia. x 6 $\frac{1}{2}$ " dowels (bottom)
E	2	36" long, or to suit, leather thongs (to hang planter)
F		6d casing nails (as reqd.)
Misc.		Resorcinol glue.

3 Large-capacity floor planter

Use this pretty plant stand to accent the corner of a patio or use several of them to break the monotonous lines of a long deck railing.

Construction of the plant stand is as straightforward as with the previous projects. Start by cutting all members to size. Then bore the drain holes in the bottom piece (D).

As with the trellis planter, fasten the cleats (C) first to four of the sideboards (B). Then nail and glue the

side boards to the legs (A) as shown in the drawing of the assembly below, left.

Join the four sides together with screws. Counterbore and plug for a finished appearance. Finally, drop in the bottom of the stand (D) and use finishing nails through the sides to secure it firmly.

Use only galvanized fasteners on this and all projects that will be exposed to water.

MATERIALS LIST—STANDING PLANTER

Key	No.	Size and description (use)
A	8	$\frac{3}{4}$ x $3\frac{1}{2}$ x 24" redwood (leg)
B	12	$\frac{3}{4}$ x $3\frac{1}{2}$ x 21 $\frac{1}{4}$ " redwood (side)
C	4	$\frac{3}{4}$ x $1\frac{1}{2}$ x 20 $\frac{1}{4}$ " redwood (cleats)
D	1	$\frac{1}{2}$ x 21 x 21" exterior plywood (bottom)
E	8	No. 10 x 2" fh screws
F	12	No. 10 x 1 $\frac{1}{4}$ " fh screws
G		10d casing nails (as reqd.)
H		6d casing nails (as reqd.)
Misc.		Resorcinol glue.

4 Patio wine rack

This rack was made to fit the beverage compartment of the barbecue bench shown on page 89. It will hold six bottles and prevent

trips in and out of the house once your party gets started.

Boring true holes is particularly important for this project. Otherwise, the result will be out of square. Once all the members have been cut and holes bored, apply a small amount of glue to each hole and assemble. Make certain that you allow the glue to dry.

To prevent the rack from pulling apart under stress, drill lead holes at each joint and pin the dowels in place with $\frac{1}{2}$ -in. brads. Neglecting to drill these important lead holes will, in all likelihood, cause splitting of the rack.

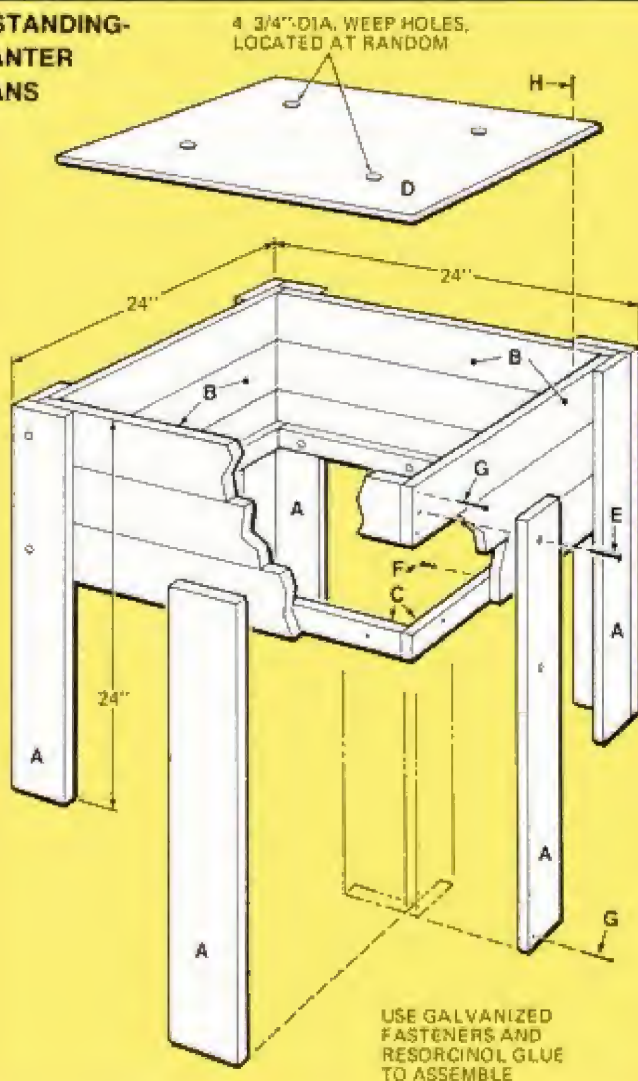
Note: The barbecue bench into which the wine rack fits was constructed of lightweight, concrete building blocks. White-painted pine or exterior plywood forms the lower shelf and pine or hardwood, such as maple, was used as the food-preparation surface.

PM

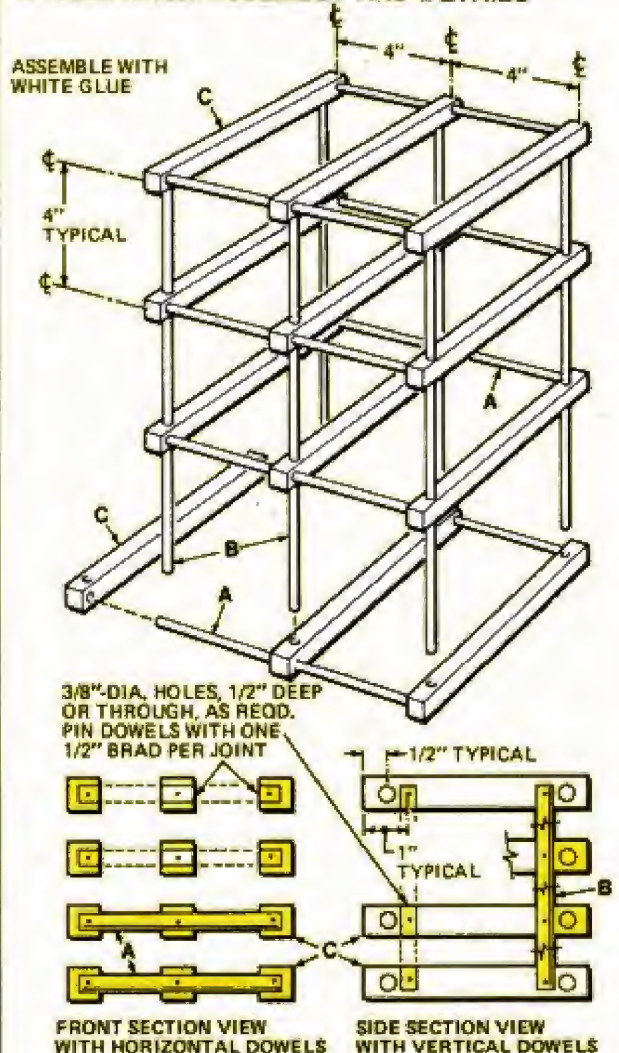
MATERIALS LIST—WINE RACK

Key	No.	Size and description (use)
A	8	$\frac{3}{4}$ "-dia. x 8 $\frac{1}{4}$ " dowels (crosspiece)
B	6	$\frac{3}{4}$ "-dia. x 12 $\frac{1}{4}$ " dowels (uprights)
C	12	$\frac{3}{4}$ x $\frac{1}{2}$ x 8 $\frac{1}{4}$ " pine (rails)
Misc.		Resorcinol glue.

3. STANDING-PLANTER PLANS



4. WINE-RACK ASSEMBLY AND DETAILS





Build this treetop hideaway for your youngsters

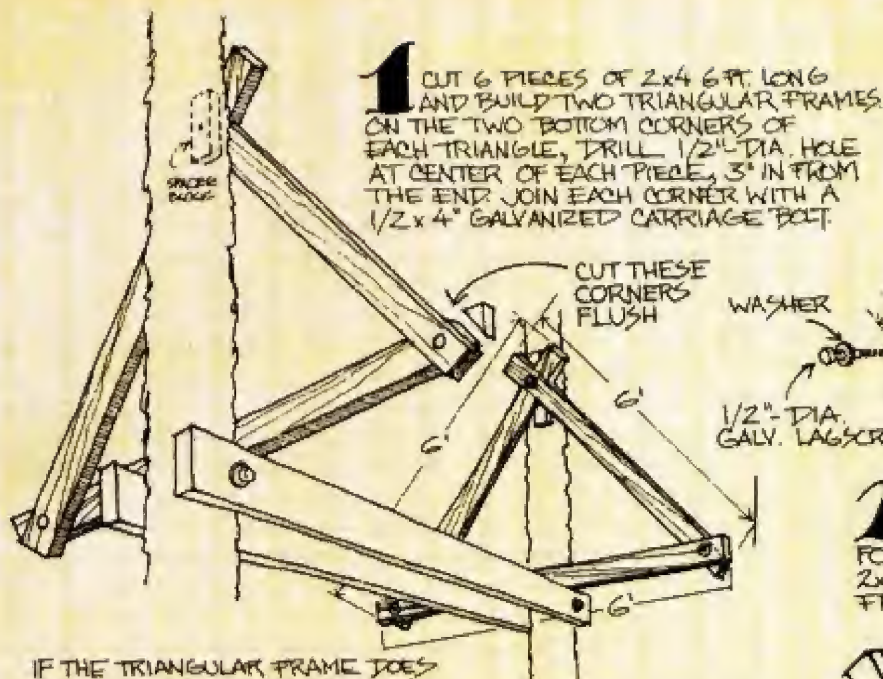
by Harry Wicks
HOME AND SHOP EDITOR

Artwork on the facing page is from The Tree House Book, copyright © 1979 by David Stiles, and is reprinted by permission of Aven Books. The book sells for \$3.95 at bookstores.

Not all do-it-yourself is of the maintenance, must-do variety. The tree house shown on these pages is a good example of a project that is lots of fun to build, as well as use. If your youngster is old enough to want a tree house, he is also old

enough to share in a rewarding building experience. This project is a fine opportunity for Pop to pass along some know-how, and for Junior to appreciate the value of using something he has built himself.

The house shown is one of four de-



1 CUT 6 PIECES OF 2x4 6 FT LONG AND BUILD TWO TRIANGULAR FRAMES ON THE TWO BOTTOM CORNERS OF EACH TRIANGLE, DRILL 1/2"-DIA. HOLE AT CENTER OF EACH PIECE, 3" IN FROM THE END. JOIN EACH CORNER WITH A 1/2 x 4" GALVANIZED CARTRIDGE BOLT.

CUT THESE CORNERS FLUSH

WASHER

1/2"-DIA. GALV. LAGSCREW

NOTCH BOTH PIECES OF 2x4 AT THE TOP OF THE TRIANGLE 6" FROM THE ENDS, SO THEY FIT INTO EACH OTHER TO FORM A FLUSH JOINT. THEN BORE A 5/8"-DIA. HOLE THROUGH THE CENTER OF EACH TRIANGLE TO THE TREE WITH A LAGSCREW. AT LEAST 1-1/2" OF THE LAGSCREW SHOULD PENETRATE THE TREE.

2 FRAME THE STRUCTURE AS SHOWN USING 2x4s FOR FLOOR JOISTS AND 2x3s FOR THE WINDOW FRAME.

SPACER BLOCK IF NECESSARY

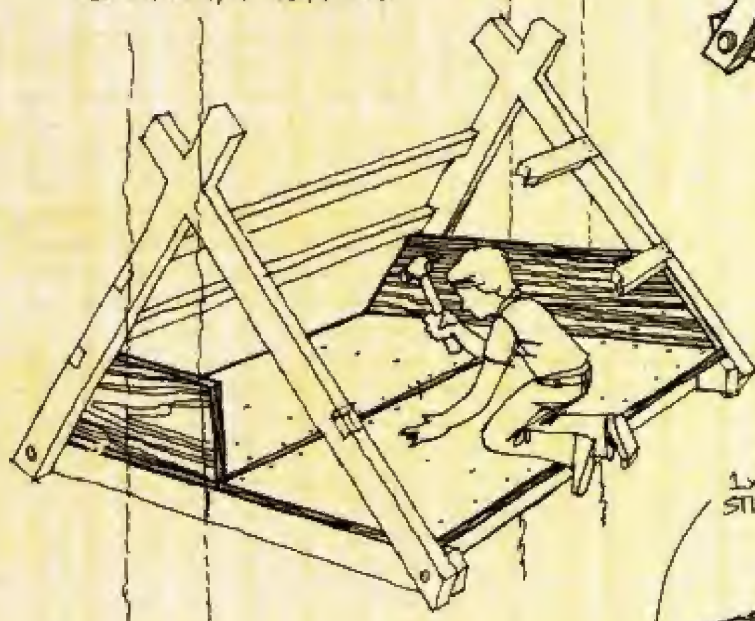
WINDOW FRAME 2x3s

2x4 FLOOR JOISTS

2x4 HEADER

IF THE TRIANGULAR FRAME DOES NOT REST VERTICALLY (PLUMB) AGAINST THE TREE, MAKE A SPACER BLOCK FROM SCRAP 2x4 AND WEDGE IT BETWEEN THE FRAME AND THE TREE.

3 FLOOR AND END PANELS ARE CUT FROM TWO SHEETS OF EXTERIOR GRADE 3/4" PLYWOOD.



1x4 STIFFENER

ASPHALT OR CEDAR SHINGLES

1x4 PROP

15 LB FELT

5/8" PLYWOOD SHEATHING CUT INTO 2'-WIDE PANELS

PERMANENT LADDER MADE FROM 2x4s AND 1-3/8"-DIA. DOWELS

HAND HOLD, CUT IN FLOOR, MAKES IT EASIER AND SAFER TO CLIMB UP LADDER.

4 THE ROOF IS MADE FROM THREE SHEETS OF EXTERIOR GRADE PLYWOOD. RIP PLYWOOD DOWN THE MIDDLE TO CREATE SIX PIECES.

In his A-frame plan detailed here, David Stiles keeps the construction super-simple to hold down the cost—as well as to eliminate the need for professional building expertise. His newly published tree-house book features three other basic designs in addition to the A-frame shown. For the safety of the children, be sure that you pick two healthy trees of adequate size and that you anchor your tree house securely to them.



To level beams, secure one end with lagscrew and swing board up until level. Mark tree, secure second end with lagscrew.

Next, secure the two end triangles to tree and beams. The shim between tree and triangle assures a plumb structure.



The floor is framed and skinned to provide a safe working platform so that the work on the A-roof can proceed.

signs offered in the book by David Stiles. We chose the A-frame for its simplicity of design and ease of construction. Building details on page 93 clearly spell out how the structure goes together, although the book provides additional drawings not shown here.

Preliminary planning

Start by picking the two trees which the unit will be built in. Ideally, these will be in the kids' corner of the yard and away from gardens, decks and the like. They should be sturdy and healthy, and the site should be within easy view of the house (so Mom can make periodic visual checks).

Locate the floor no more than 6 ft. above the ground. Greater height adds nothing to the treehouse effect and, in fact, can make it more difficult for occasional parental inspections.

If you decide to create any custom items (such as built-ins) on your tree house, give priority consideration to safety. For example, do not over-build walls or openings so that it would be impossible for an adult to squeeze through them. Make certain that no locks are used on the outside of the house to avoid any chance that one youngster might lock another one inside. And be sure that access ladders, ropes and the like are permanently affixed.

A good safety feature to consider is a "soft" area beneath the structure. To install it, simply lay out a square or rectangle approximately 6 ft. wider and longer than the structure itself. Install a perimeter of 2x6s. Excavate the interior to a depth of 6 in., then fill the hole with mason's sand.

Selecting materials

You may prefer to paint your completed house but the wisest route is

to pick materials that call for a minimum of maintenance—yet retain their looks. By selecting either redwood or pressure-treated lumber you will eliminate time-consuming and expensive periodic painting. Both types of wood age to a handsome silver patina and the house will be a visual asset in most back yards.

The roof and the floor should be skinned with exterior grade plywood. Although the drawings call for $\frac{3}{8}$ -in.-thick material, $\frac{1}{2}$ in. is adequate and using it will save you a few pennies. The roof should be covered with 15-lb. felt followed by either asphalt or a layer of wood shake shingles.

The floor can be left as is as long as the plywood edges are protected from moisture. (Even exterior-grade plywood will delaminate eventually if left exposed to the weather.)

Building the A-frame

Start by measuring the distance between the chosen trees and cut the pair of 2x6s for the beams. Locate and bore the shank holes for the lagscrews in both ends of both boards. (Note: The shank hole should allow the screw to pass through easily; i.e., use a $\frac{3}{16}$ -in. bit for a $\frac{1}{2}$ -in. lagscrew.)

Position the first end of the board at the correct elevation and use the prebored hole to locate the screw position on the tree. Bore the pilot hole in the tree to receive the screw. Have a helper hold the board firmly in position while you install the lagscrew.

Slip a washer on the screw before passing it through the 2x6. Do not tighten the screw fully at this time; leave the screw loose enough so that the board can be swung up and leveled.

While your helper holds the board level, mark the second tree for the

second lagscrew. Bore the pilot hole and install screw as before. Repeat the procedure for the second 2x6, making certain it is level with the first one. There should be at least $1\frac{1}{2}$ in. of lagscrew embedded in hardwood trees and $2\frac{1}{2}$ in. in softwood trees. Finally, turn all four lagscrews tight.

Making the triangular ends

Next, build the two end triangles. It is easiest to assemble these on the ground; then install them on the beams. For this, you *must* have a helper; there is simply too much weight for one person to hold steady while locating and boring screw and bolt holes. Notice that all frame assembly is with lagscrews and carriage bolts; since they are exposed to the weather, use only galvanized hardware.

If both end triangle panels are built accurately, they will be perfectly level when set upon the main beam. While both panels are still on the ground, carefully align them and mark both for positioning on the beam.

With end panels installed, the floor can be framed and skinned with plywood. This way you will have an ample deck to work upon while completing the house. Install floor joists using 12d galvanized common nails spiked through header joists into joist ends. Add several toenails through joists into the beams. Horizontal roof rafters are installed by spiking through the rake rafters on the ends.

Cover the roof with plywood and shingles, build the ladder and install. Designer Stiles suggests leaving the house window- and door-less to maintain a "welcome" attitude to neighborhood kids. If you install windows, make them of a sheet acrylic, such as Plexiglas, to avoid any accidents.

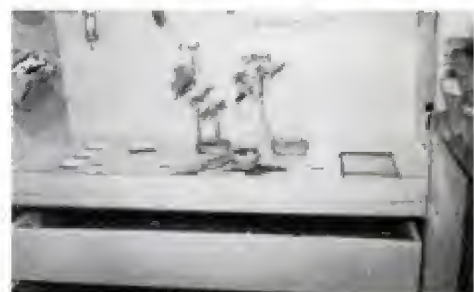
PM



The 3-ft.-wide storage area, which forms outside wall of carport, holds bench.



Potting tools are hung on pegs; shelves for pots are installed between wall studs.



Holes in work surface are sized to hold the pots being worked. Excess soil pushes through to the drawer below for storage.

store pots, peat moss, fertilizer and sprinkling can. If there is any floor dampness, construct a removable duckboard-style floor rack for these items.—*Ralph S. Wilkes*

Put a potting bench in a spare corner

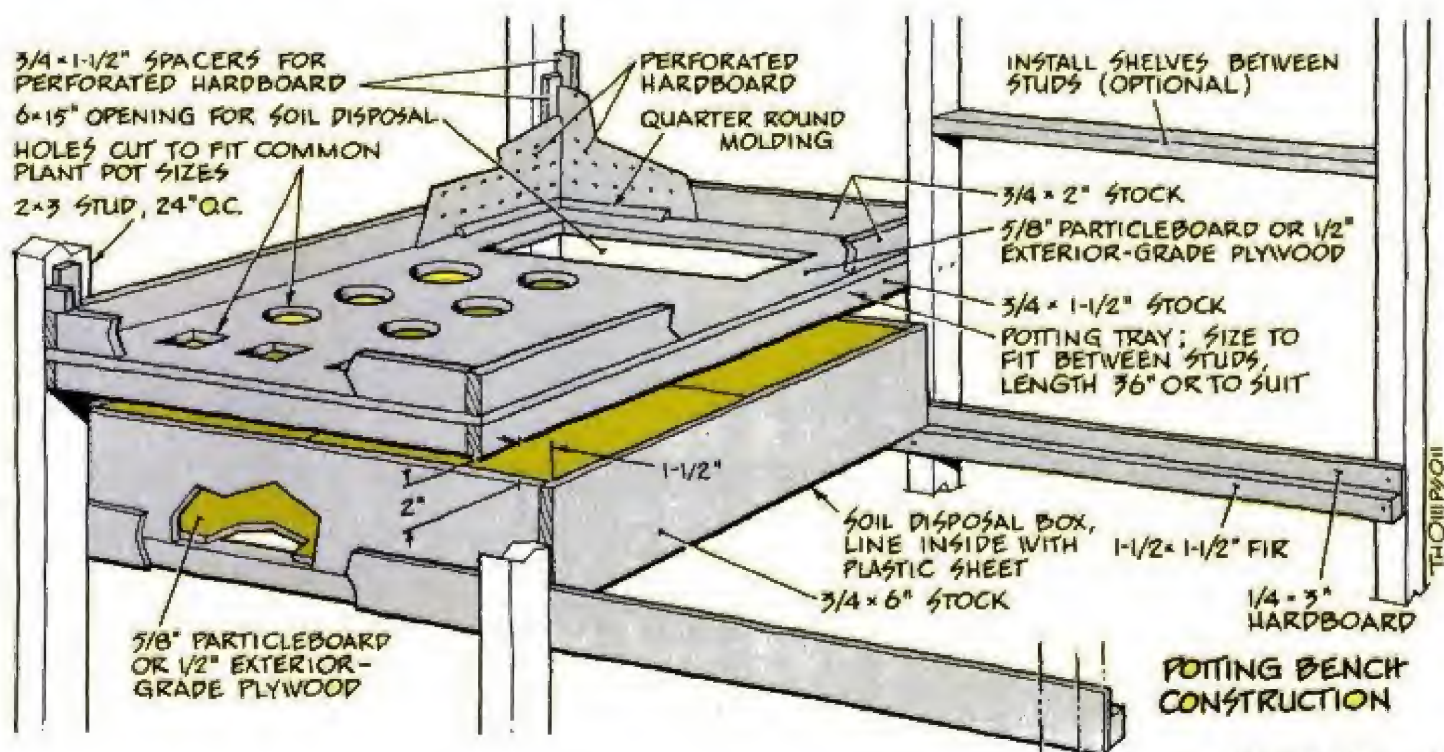
Repotting house plants and transplanting vegetable seedlings from flats to pots can be messy and time-consuming if you're not fitted out for the task. However, not many of us have the space or time to build a full-fledged potting bench.

Charles and Judith Morgan of Ruxton, Md., solved the problem by designing this compact bench. They constructed it in the storage enclosure which supports the outboard end of their carport. It also could be built in the corner of a garage or in a basement, if you add a supporting partition.

The bench consists of a tray with

pot-holding and soil-disposal holes—and a drawer below to store unused soil. Perforated hardboard surrounds the work surface and organizes tools. A fluorescent fixture with two 40-watt tubes is mounted on the ceiling to provide good lighting. Two 250-watt, infrared bulbs, installed above and in back of the operating position, provide heat when needed.

For easy cleaning, prime and coat all surfaces that contact the soil with a durable, exterior enamel. Line the inside of the soil storage drawer with a plastic sheet. Use the floor space beneath the bench to





Build PM's modular barn

If you need a versatile outbuilding, but don't feel like spending warm-weather months putting it together, consider preassembling this modular barn/storage shed during the winter months. Maximum size of the panels is 4 x 8 ft., so each module can be built in the basement or garage and put together where and when you wish.

Finish details, like shutters, window box, weather vane (functional) cupola (with birdhouse) and Dutch doors can also be preassembled and stacked against the wall of the ga-

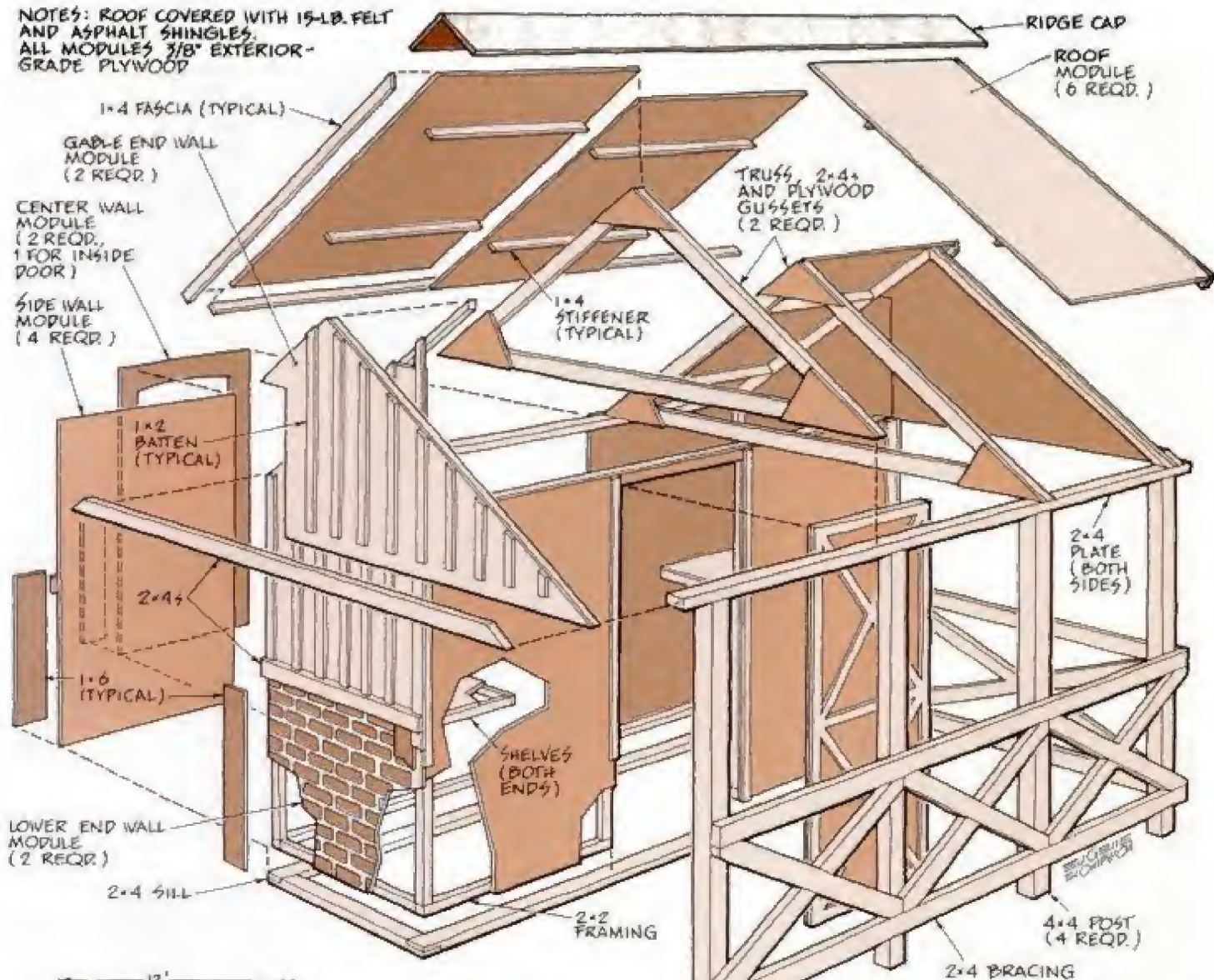
rage or shop while awaiting assembly time. The wall modules are even prefinished, right down to the painted brick pattern, to speed up final construction. Used windows can be incorporated in your barn to save money. The floor plan is divided into two areas, one enclosed for weather-tight, lockup protection and a larger area that can either be left open or enclosed. The large portion works as a stable, small carport, woodshed, or a shed for rolling stock like garden carts, mowers, tractors and the like.

PM



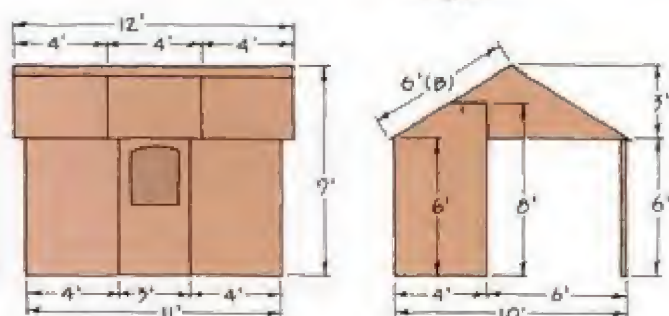
Large, open section of barn can work as a stable, woodshed or carport for a compact auto; enclosed section holds tools.

NOTES: ROOF COVERED WITH 15-LB. FELT
AND ASPHALT SHINGLES.
ALL MODULES 3/8" EXTERIOR-
GRADE PLYWOOD



HOW TO ORDER PLANS

Complete plans for PM's modular barn, including how-to-build instructions and a list of materials, are available for \$7. Send your check or money order to PM Barn, Stevenson Publications, Box 584, Del Mar, Calif. 92014. Allow two to four weeks for delivery for third-class mail; add 75 cents if you prefer faster, first-class mailing.



MODULE DIMENSIONS



The barn is built of preassembled panels, small enough to be constructed in a garage or shop during the winter months.



On-site assembly took the designer, his son and friend one day to complete—although all of the steps can be handled by one man.

PM's tabletop lathe: A great

You needn't be a machinist to build this little beauty—it's made of hardwood.

by John Gaynor

The chips really fly when you go to work on this little, homemade hobby lathe. The tool turns small wood parts for toys, models and other miniatures with precision.

Although the lathe is designed to be powered by a Dremel Moto-Shop, it works with any motor of about 3400 rpm. If the motor has a higher speed, a variable-speed control allows you to dial the rpm setting to suit. Cost of materials, including the spur center and faceplate (both from Dremel), is about \$6.

For a smooth finish, sand all parts with 120-grit sandpaper and dust with a tack cloth. Spray with two coats of Krylon No. 1301 clear lacquer, rubbing with 4/0 steel wool and dusting with a tack cloth between coats.

Cut the motor bracket parts (M and N) and assemble with glue and screws. To assure alignment of live



Our lathe project is designed around Dremel's Moto-Shop; you will have as much fun building the lathe as you will creating turnings on it. High-quality work, like the turnings here, can be produced after a few practice sessions.

PM photos: Rosario Capotosto

point (C) with spur point, bore holes for the lathe-bed fasteners only after the bed and tailstock are assembled.

Cut the groove in the lathe bed (O). This groove receives the tailstock carriage bolt (D) and the toolrest

(Please turn to page 104)



1 Groove the lathe bed and cut a slot with the Moto-Shop. Bore holes at the slot ends for blade entry and maneuverability.



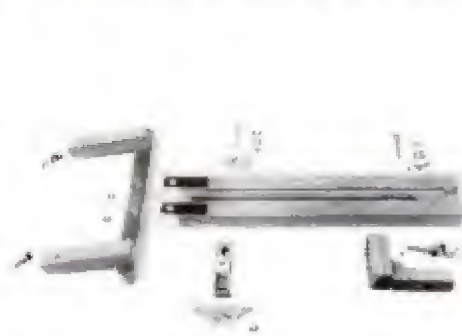
2 Next, cut out the toolrest with jigsaw; bevel face after sanding or planing.



3 Use a hand grinder and end-milling bit to shape the small recess on the toolrest. First mark borders with knife cuts.



4 To guarantee true alignment, locate the hole for the dead center by pushing the tailstock into the live-center spur point.

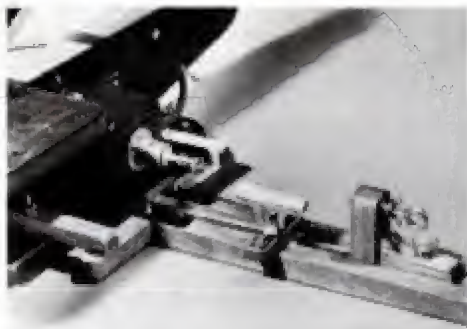
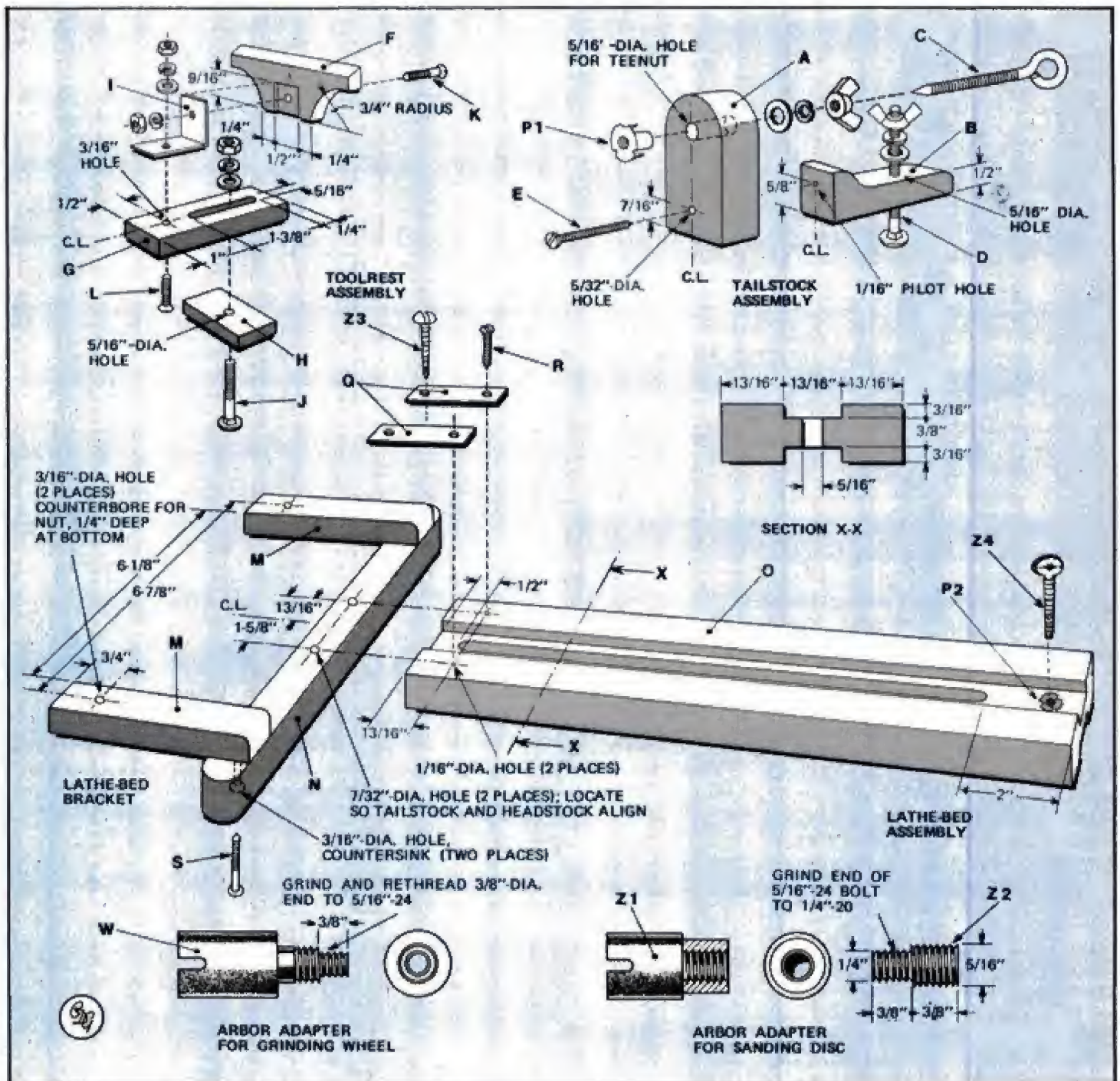


5 The parts are ready to assemble. Stock is oak, but you can use any hardwood.



6 Bore mounting holes in the saw base after centering the attaching bracket.

tool for miniature makers



7 The finished lathe is ready for use. You can purchase the live-center spur and lathe chisels at any Dremel supplier.



8 You can turn quite intricate spindles using your small chisels and this lathe.



9 With practice, you can do faceplate turning and achieve excellent results.

WORKSHOP MINICOURSE

BENCH PLANE, PART 2



Hold the iron and cap securely and tighten the screw that holds the parts together.

In last month's *Workshop Minicourse* on the bench plane (page 102), we left off with the blade and cap iron aligned. The first step (above) in this month's discussion shows the lever cap screw being turned home to hold that assembly rigid.

Though basically a simple tool, there is much more to assembling and using a plane than its looks might imply. It is important that you understand tool assembly so that you can get the tool back together exactly as it should be. Failure to correctly assemble the bench plane is sure to bring about failure using it.

But let's back up a bit. Anytime you take your plane apart or adjust the blade, first inspect the plane iron. Check for sharpness and hone it slightly, if necessary. If the iron sports ungainly nicks or the like from rough usage, grind the blade before honing. Reassemble the iron and its cap so that the sharp edge of the cap iron is tight against the small, flat surface next to the cutter (which it bears upon) when they are screwed together. This will prevent shavings from working between them; keep in mind that the cap iron is intended to serve as a shavings deflector.

Assembling the plane

When you put the assembly in the plane, make sure that the cap iron is on top and on the unbeveled side of the plane iron. The blade's beveled side *must be down* when in the plane.

Slip the lever cap over the screw and snap the lever cam down to lock it in place.

Hold the plane in your left hand



The plane is assembled with the plane iron laid bevel-side down. You should make certain that the end of the Y-adjusting lever, the roller on the lateral adjusting lever, and the head of the plane-iron cap screw are seated correctly.

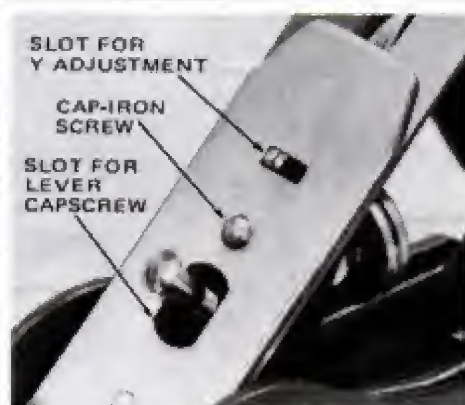


Slip lever cap under the lever cap screw and push the cam down. The iron should be held firmly with the cam in place.



Sight along the plane's bottom (dotted line) while you adjust the plane's blade in or out using the adjusting screw (arrow).

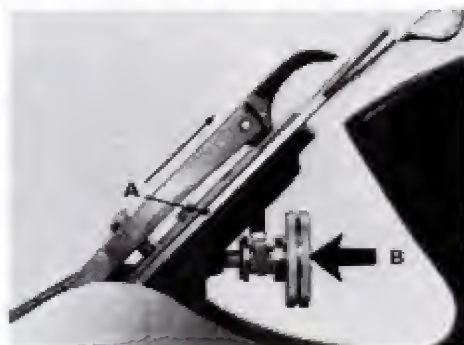
and sight along the bottom to adjust the iron. With your right hand, move the adjusting lever until both corners of the blade project the same distance from the throat. Then use the adjusting nut to project the blade through the throat and slightly beyond the plane bottom. In the next plane installment, in the October issue, we will discuss the lateral adjustment and more. **FM**



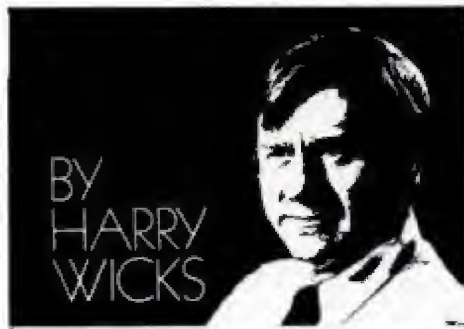
Properly installed iron assembly lies flat in the plane, as shown above. Notice Y-adjustment lever is in its slot.



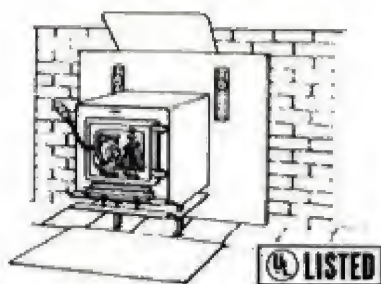
If the plane iron is not held securely when the cam is in place, remove the lever cap and slightly tighten lever cap screw.



Plane Iron A is retracted (arrow) when adjusting knob moves in direction of arrow B. To push blade out, reverse knob rotation.



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PM TESTS NEW MINI PICKUPS

(Continued from page 63)

are rated by the Environmental Protection Agency (EPA) at over 20 mpg. They can get you into the back country with room to spare and they are more maneuverable than their bigger cousins from Detroit. The Toyota and the Datsun are available with larger storage beds and maxi-sized cabs. To keep the testing even, though, we chose the base models offered by all the companies.

The off-road portion of the test took place at Saddleback Park in Orange County, Calif. The street testing was done on the freeways and side streets of Orange County and Los Angeles. We lived with the trucks for a couple of weeks, and formed some opinions, positive and negative, about all four of them. We put each 4x4 through its paces to explore its unique personality traits. First, we'll sum up our opinions and then we'll tell you how we formed them.

We liked the Toyota and the Subaru best. The Toyota seemed to exemplify everything about a workingman's 4x4 that we could think of. It is a bit bigger and more massive than the other trucks, in places where it counts. It is also wider and taller than the others.

The Toyota has the most functional and easiest-to-read-and-operate dashboard and air/heat controls. It has the largest gas tank and the biggest engine for the most pulling power. It is also the most expensive, but we think you get your money's worth. It doesn't get as good mileage as the other trucks, but we think that is because Toyota built this truck with endurance and working ability first in mind, economy second. It weighs more than the other three trucks we drove. If we had to pick one truck we were going to drive to the job site, one truck that we had to depend on as part of making our day-to-day living, it would be the Toyota. It's the most serious of all the 4wd mini pickups we tested.

We liked the Subaru for all the opposite reasons. If ever there was a

sleeper, if ever there was a vehicle that held a lot of hidden promise, it is the Brat. It is smaller, lighter, less expensive and sportier than all the other trucks. So much so that the word *frivolous* comes to mind when trying to think of one all-encompassing term for the truck, but it sure is fun.

It comes with carpeting in the back bed and two jump seats with handholds as standard equipment; so this is not any kind of serious hauling vehicle. This is a pleasure machine and sports car rolled into one. The Brat went quicker and stopped faster and used less gas than its competition. It comes with front-wheel drive, which makes for some unnecessary excitement on the paved road, because the back end desperately wants to say hello to the front end whenever you take a turn even a bit over the legal limit. This is because all the weight, as well as the driving wheels, are in the front. But flip the floor lever into 4wd and you've got yourself a little wonder rig that never falters off the road.

The Brat, which we at first considered to be the little baby of the four trucks, the truck most likely to get stuck in the tough stuff, proved itself worthy at every turn during our sometimes rugged dirt testing. It went everywhere the big trucks went and it never complained.

The Chevy Luv (Light Utility Vehicle) by Isuzu is really a Chevrolet at heart. Don't let that import sticker fool you. The Luv was hearty, dependable and never faltered, just like every Chevy you ever owned.

The Luv comes stock with a bench seat, and we like that change from the buckets, which tended to waste space in the cabs rather than create it. Even with the bench-seat arrangement, the shifting levers for gear box and transfer case were easily within reach.

The Luv didn't come with a trip odometer on the dash, something you'd better have when heading for

SPECIFICATIONS AND TEST DATA—MINI PICKUPS

	Chevy Luv	Datsun	Subaru Brat	Toyota SR5
Length	173.8 in.	171.7 in.	164.8 in.	170.1 in.
Width	63.2 in.	63.4 in.	61 in.	66.5 in.
Height	60.8 in.	63.4 in.	56.7 in.	65.9 in.
Ground clearance	7.5 in.	8.8 in.	7.1 in.	7.9 in.
Fuel tank	13 gal.	13.2 gal.	11.9 gal.	13.7 gal.
Weight	2585 lbs.	2788 lbs.	2200 lbs.	2815 lbs.
Engine displacement	1817 cc	1952 cc	1595 cc	2189 cc
EPA (highway)	22 mpg	20 mpg	26 mpg	20 mpg
Base price	\$6383	\$6419	\$5398	\$6498
Tires, tread	Goodrich T/A F70-14; 6 in.	Dunlop Cross Lug G78-15; 8 1/2 in.	Bridgestone Mud and Snow 155SR-13; 5 in.	Dunlop Snow Cruiser H78-15; 6 in.
0-50 mph (2-wheel)	13.3 sec.	16.8 sec.	11 sec.	13 sec.
0-50 mph (4-wheel)	14.1 sec.	17.4 sec.	11.2 sec.	14.2 sec.
Braking (50-0 mph)	71 ft.	89 ft.	60 ft.	75 ft.

the back country, but it did have one neat feature none of the other trucks could claim. Borrowing a note from their motorcycle-making friends in Japan, Isuzu designed the Luv 4x4 so that it couldn't be started unless the clutch is depressed. This could mean you might have to use the parking brake in off-road situations when you start the rig on an incline, but it does provide a nice extra measure of safety.

The Luv comes with perhaps the finest tires of all the 4x4s we tried (Goodrich radials) and the Luv was without a doubt the most comfortable truck on paved highway. On the road, it didn't feel like a truck; in the dirt, it could more than take care of business.

The best and most innovative thing about the Datsun 4x4 is that it has the only independent front suspension of all the trucks and also has the most ground clearance.

The Datsun had no trouble keeping up with our 4x4 caravan off the road, and in fact led many of the miles we traversed in the dirt.

There were things about the Datsun we didn't, especially like. The steering arms were about 3 inches off the ground, as they were admittedly low on the Luv truck. In contrast, things like steering arms and exhaust systems are nicely tucked away on the Brat and Toyota. The Datsun and Luv, to a certain extent, failed in some of these packaging areas. You have to take things like that into account when you are talking about buying a vehicle for going off the road.

The Datsun does have an identity crisis. It doesn't know whether it is a serious 4x4 for the workingman or a fun truck like the Brat. But a lot of people will probably buy it because it is such a good-looking vehicle.

Final results? The Toyota wins overall for construction quality and utilitarian image. The Brat finishes second for price, economy and performance, and for not being afraid to be nothing more than what it is: a fun toy for big kids. The Chevy Luv comes in a close third. It ran best on the road and provided the kind of creature comfort we've come to expect from the Chevrolet marque. The Datsun brings up the rear with a nice first-year effort.

The results of the test didn't surprise us. Toyota and Subaru have the most experience in building 4x4s. So it's nice to see that they were able to translate all their experience into the mini pickup so successfully.

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BUILD PM'S TABLETOP LATHE

(Continued from page 98)

carriage bolt (J). Bore a hole near the end of the lathe bed for the leveling Teenut (P2).

Cut tailstock parts (A and B). You can determine the height of the live (bolt) center (C) after fastening together the bed, bracket and motor. To avoid splitting, round off the top of the tailstock only after tapping in the Teenut (P1).

Cut toolrest parts (F, G, H). Floating spacer (H) is primarily used to retain the toolrest height when us-

ing a faceplate. Bevel the top edge of the toolrest at a 45° angle.

Dremel's spur center and faceplate receive a 3/16-in.-dia. × 24-thread shaft (W). If you use power other than the Moto-Shop, you must adapt it to these accessories.

With a 3/16-in.-dia. × 24-thread die (about \$1.50), you can grind most shafts or arbors by holding a flat file against the turning shaft until a 3/16-in. dia. is reached. By chucking a 1/4-in. eyebolt in your drill, you can grind a live point (C).

For information on Dremel products or parts, write: Dremel Manu-

facturing Div., Emerson Electric Co., 4915 21st St., Racine, Wis. 53406. **PM**



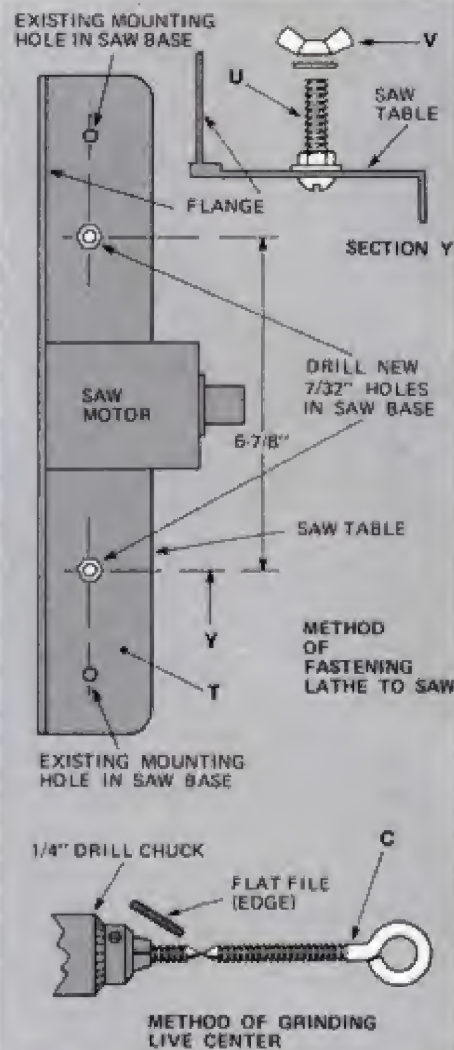
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MATERIALS LIST—TABLETOP LATHE

Key	Amt.	Size and description (use)
A	1 pc.	3/4 × 1 1/4 × 2 1/2" hardwood (tailstock)
B	1 pc.	3/4 × 1 × 2 1/2" hardwood (tailstock guide)
C	1	1/4-20 × 2 1/2" eyebolt and corresponding washer, lock washer and wingnut; grind end to point (live center)
D	1	1/4 × 1 1/2" carriage bolt and corresponding washer, lock washer and wingnut
E	1	1 1/4" × No. 6 panhead screw
F	1 pc.	3/4 × 1 1/4 × 2 1/2" hardwood (toolrest)
G	1 pc.	3/4 × 3/4 × 2 1/4" hardwood (toolrest base)
H	1 pc.	3/4 × 3/4 × 1 1/4" hardwood (floating spacer)
I	1	1 × 1" steel corner brace; grind leg attached to F to 3/16" length
J	1	1/4 × 1 1/2" carriage bolt and corresponding washer, lock washer and hex nut
K	1	No. 8-32 × 1/2" machine screw and corresponding lock washer and hex nut
L	1	No. 8-32 × 1/2" machine screw and corresponding washer, lock washer and hex nut
M	2 pcs.	3/4 × 3/4 × 4" hardwood (bracket)
N	1 pc.	3/4 × 3/4 × 8 1/4" hardwood (bracket crosspiece)
O	1 pc.	3/4 × 2 1/4 × 12 1/4" hardwood (lathe bed)
P1	1	1/4-20 Teenut
P2	1	No. 8-32 Teenut
Q	2	1/2 × 2" mending plates
R	2	3/4" × No. 6 machine screws
S	2	1" × No. 6 machine screws
T	1	Dremel Moto-Shop
U	2	No. 10-24 × 1" rh machine screws and corresponding lock washers and hex nuts
V	2	No. 10-24 wingnuts and washers
W	1	Dremel Moto-Shop modified arbor adapter
Z1	1	Dremel Moto-Shop arbor adapter
Z2	1	Sanding-disc fastening stud
Z3	2	1" × No. 6 panhead sheet-metal screws
Z4	1	No. 8-32 × 1" thumbscrew

Misc.: Franklin Tsetbond glue; Krylon No. 1301 clear lacquer; 4/0 steel wool; 120-grit sandpaper.



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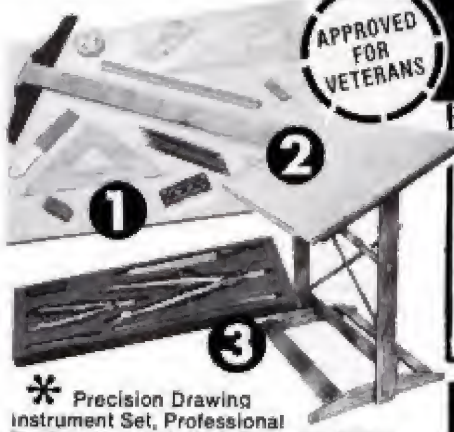
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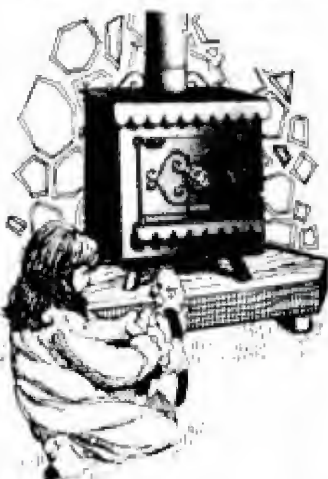
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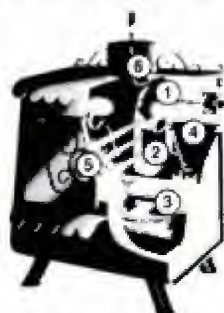
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COMPUTERS TALK, CONTROL YOUR HOUSE, SING

(Continued from page 81)

tion. This is quite handy but, when coupled to the C4P MF, it becomes fantastic. The computer can be programmed to do the button pushing—all automatically, and orchestrated to your own rhythms of living.

Coffee at 7:00 a.m. on weekdays and 11 on weekends? The C4P MF can be told your preference and will never turn your coffee pot on too late for a commuter's Monday, or disturb a hard-earned Sunday's sleep.

Best of all is what Ohio Scientific calls its "background" feature. You can still use the computer for other things while it is minding the house. It will continually run the house control program in the "background" of its memory, while the "foreground" plays Ping-Pong or forecasts stock-market futures.

Lots of color and sound

As might be expected from a company that has made a name for itself in games and arcade devices, Atari has lavished attention on the 800's display and audio capabilities. If you are interested in sound and colorful displays, check out the 800.

Though the other computers also offer color graphics, we found the Atari's to be the easiest to program for quick and lively on-screen animation. Colors and resolution were excellent.

Sound, too, was simple to program and—to our ears—sounded the smoothest and easiest to use in a true musical manner.

Anti-pirate or pro-toddler?

Both Atari and Texas Instruments use solid-state software in these new machines. The programs are in specially encoded ROM (Read Only Memory) chips within a plastic-cased cartridge. To run the program, the cartridge has only to be plugged into a slot.

Frankly, we were, and still are, less than enthusiastic about this method of program distribution. The advantages are that such programs are very simple to load. Children can quickly learn how to "use" a computer equipped with plug-in programs. The programs work every time, with no "dropped bits" due to loading glitches. Further, you don't have to worry about the delicacy of either cassette or floppy disc storage.

Disadvantages are their higher cost and the inability to change a program to meet your own personal needs or whims. This last bears investigating. Most computer owners soon become programmers. After all, the main strength of a computer is that it is a tool to extend its owner's imagination. A program on tape or disc can be changed, reprogrammed a bit or a lot.

Trouble is: A tape or disc program can be pirated. A copy can be made and given to a friend or two (or 50). There go the sale royalties for the programmer. Solid-state software cannot be copied by the user—so no pirates.

We talked with TI and they told us that, indeed, they were also bringing out tape programs for the TI-99/4. Ease of use, they told us, is the only reason they have gone to cartridges.

They certainly are easy to use. And having them in no manner handicaps you from doing your own programs from scratch. And, if a child will be using the computer, they are a plus.

Still, we hope that these companies (and others too) will not neglect the home programmer.

Read all about it

The worst thing about new computers used to be the quality of the instruction manuals. Often, only the

computer store could translate them and sometimes not even they could help.

Don't be afraid of these machines on that score. All three companies are supplying some excellent manuals and aids.

Atari even commissioned a book on Basic which will be sold separate from the computer. It's a lively and informative guide we really enjoyed reading.

Texas Instruments put a lot of obvious thought and effort into its detailed and easy-to-read manuals. From setting it up to advanced programming there are markers all along the route.

Ohio Scientific's machine comes with a huge three-ring binder of looseleaf material. Much of it will come in handy only once you really learn to program and understand the machine. But there is enough beginner material to get you going.

Hooking into other things

Ohio Scientific's C4P MF has a wealth of *ports* (computer terminology for sockets) on the back. This is probably one of the easier computers to hook up to equipment, such as printers from other manufacturers.

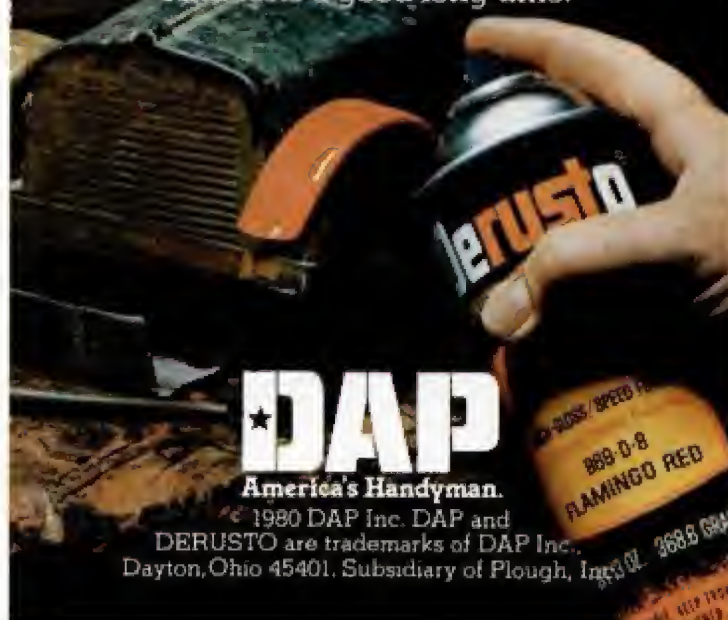
The Atari 800, however, is even easier to hook up to *Atari-only* peripherals. The only thing is that Atari has chosen a unique "daisy-chaining" hook-up system that will not (at this time) support any other manufacturer's equipment. However, its printers are reasonably priced and seemed reliable.

At the keyboards

The C4P MF and the 800 both have beautiful, Selectric-style typewriter keyboards. If you are a touch

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typist, your fingers can really fly along these keys. TI, on the other hand, opted for large, calculator-style keys. The keyboard will be liable to throw off a touch typist until he gets used to the keys.

Besides just putting letters on the screen, these machines also have capability to print out different shaped letter-sized graphic shapes. These designs allow you to build "pictures" on the screen. Atari's graphic set is available right from the keyboard and you can define others to use in programs. TI and Ohio Scientific both let you define your own shapes (and C4P MF has a number of predefined ones).

Looking into the future

Software support is a major consideration when you buy a computer. New computers such as these will, of course, not have as much software available as computers that have been on the market a while. But TI has already entered into a deal with Mattel, which will be supplying some solid-state software. And many computer software houses are now gearing up to offer Atari-compatible programs on disc and cassette tape.

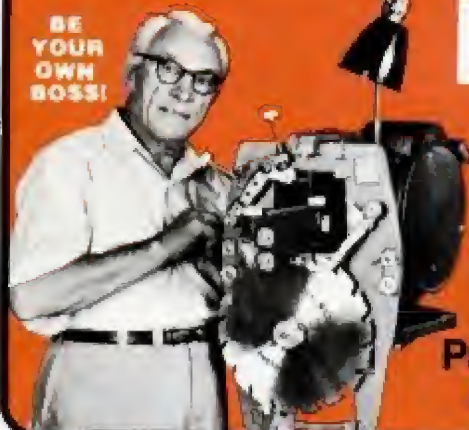
One thing you may already have noted: These machines are not cheap. The cost curve has not yet come down for state-of-the-art personal computers. Another cost to be considered is the color television for the Atari and OSI systems; TI supplies its own color monitor.

We don't foresee prices tumbling for a good long time yet. Still, the prices really are not so high when you consider the million-and-one tasks the computers are capable of tackling.

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5 handy projects for your workshop

Lathe supports for spindle turning

When turning long, slender stock on a wood lathe, stock vibration will often make it impossible to produce a smooth finish.

It's possible for you to eliminate this problem by first turning down an inch or two near the middle of the stock so a support may be used. Sand this portion smooth while you're running the lathe at a low rate of speed.

A simple support, good if you're only making a few turnings, can be made, using a V-notch for the support bearing.

Use a few drops of candle wax to lubricate the bearing surface. Clamp in place and adjust the support so that it centers and touches lightly against the turning.

To make a heavy-use version, which produces less friction, use two discarded plastic caster wheels, with nails cut to serve as axles. I found 20-penny size to have the right diameter for the wheels I used. Smooth the bearing surface of the nails with a fine emery cloth until the wheels spin freely.

By providing a free-floating roller support, the rollers will automatically adjust to any slight error in



Simple-to-make lathe accessory supports a long spindle having a V-shaped notch.



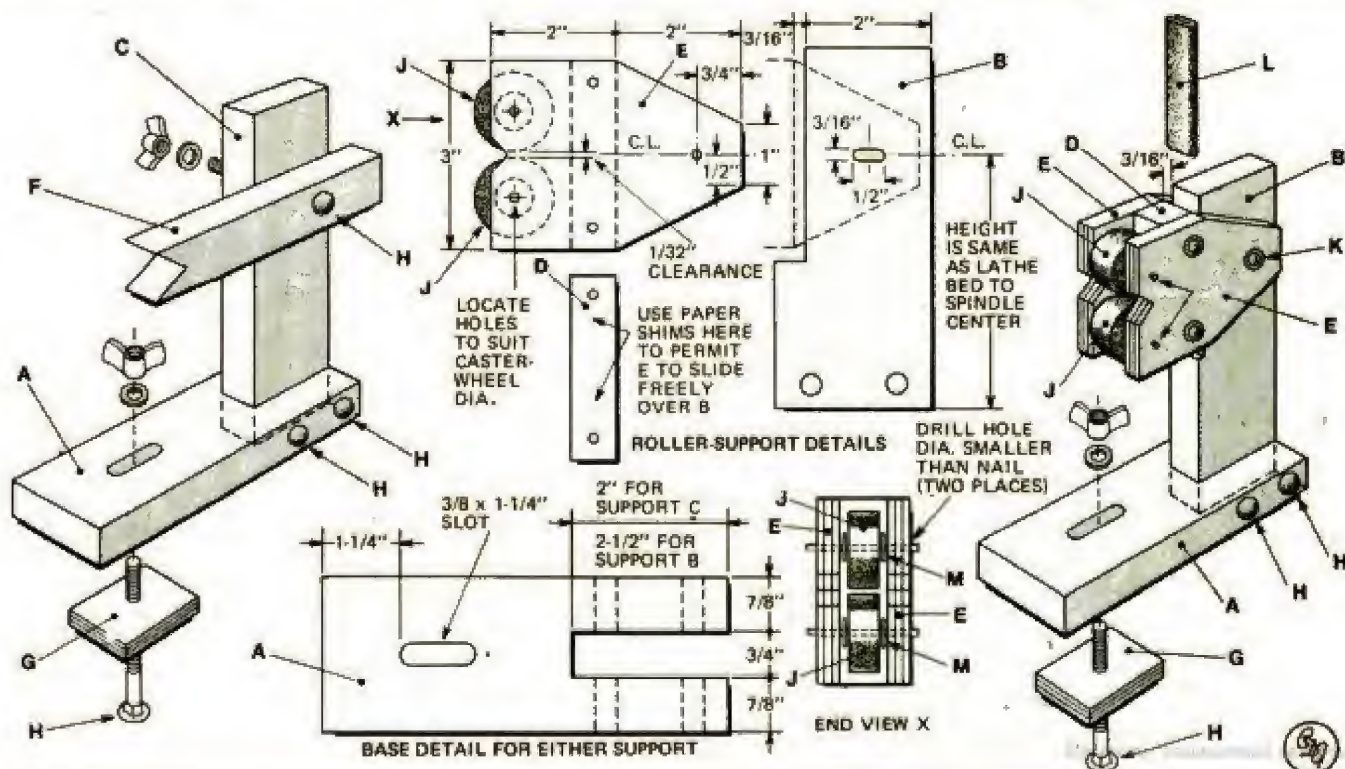
More sophisticated version, for frequent turnings, holds spindle at the wheels.

height; the rubber backing permits constant light contact with the work being turned. The rollers will last a long time if they are oiled occasionally.—*Ralph S. Wilkes*

MATERIALS LIST—LATHE SUPPORTS

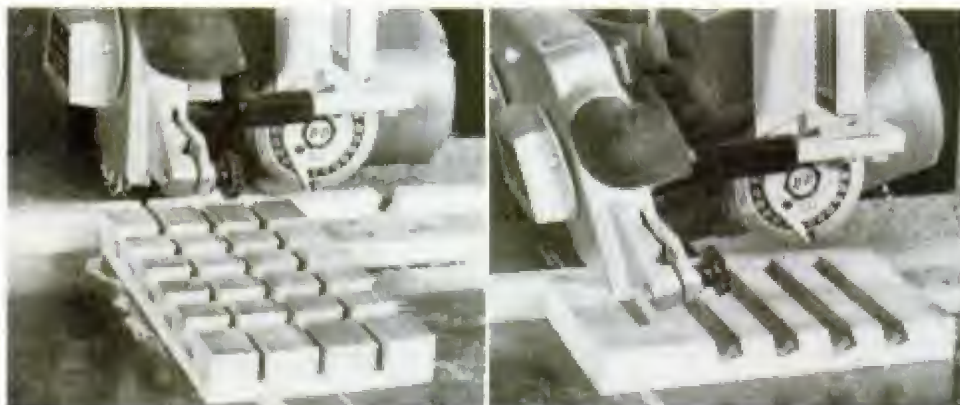
Key	No.	Size and description
A	2	$\frac{1}{4} \times 2\frac{1}{2} \times 6\frac{1}{2}$ " hardwood
B	1	$\frac{1}{4} \times 2\frac{1}{2} \times$ length to suit, hardwood

C	1	$\frac{1}{4} \times 2'$ x length to suit, hardwood
D	1	$\frac{1}{4} \times \frac{1}{2} \times 3'$ hardwood
E	2	$\frac{1}{4} \times 3'$ x length to suit, plywood
F	1	$\frac{1}{4} \times 1'$ x length to suit, hardwood
G	2	$\frac{1}{4} \times 1\frac{1}{2} \times$ length to suit lathe bed, plywood
H	7	$\frac{1}{4}$ " carriage bolt with washer and nut (wingnut where indicated)
I	3	20d nail, cut to suit
J	2	1 $\frac{1}{2}$ "-dia. caster wheel
K	3	$\frac{1}{4} \times 1\frac{1}{2}$ " rh stovebolt (with 2 washers, nut)
L	1	3 x 3" square of soft rubber tubing (fold in thirds)
M	4	$\frac{1}{4}$ " common washer

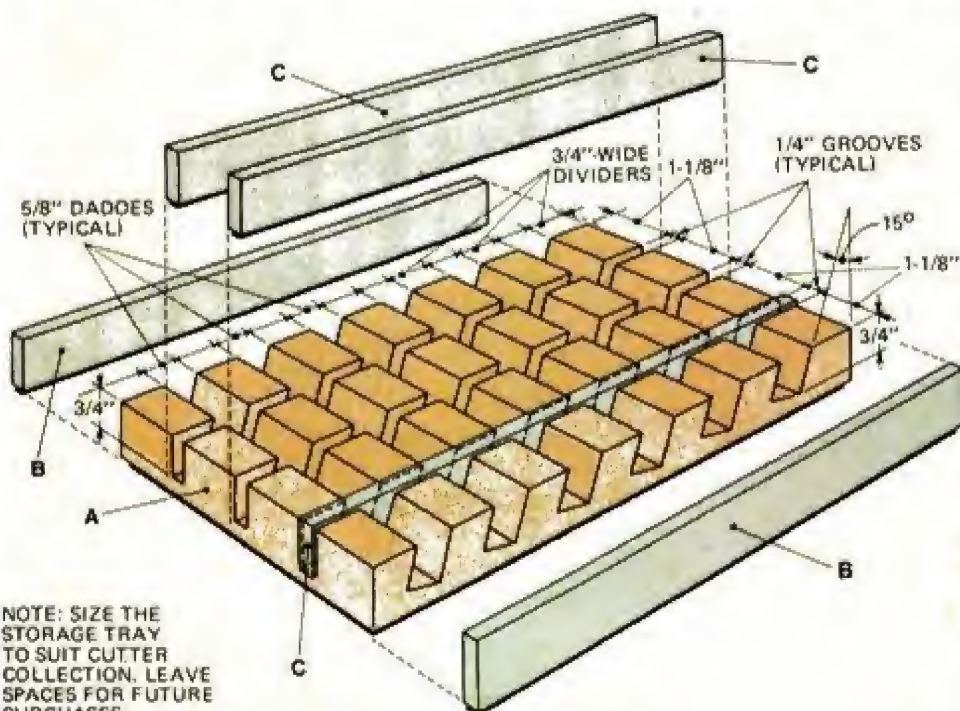




Holder keeps cutters protected and can be stowed in accessory drawer or in a cabinet.



Use a dado head on a radial-arm saw as shown, or with a table saw to plow the grooves and dadoes. Tilt saw's head 15° to create the slightly angled dadoes (right).



NOTE: SIZE THE STORAGE TRAY TO SUIT CUTTER COLLECTION. LEAVE SPACES FOR FUTURE PURCHASES.

Storage for molding cutters

Loose cutters, banging around in a drawer with other tools, are easily dulled and damaged. They also get mixed up and take time to sort and match up.

This cutter holder solves these problems by protecting the cutting edges and allowing profiles to be identified quickly.

The method for creating the egg-crate-like storage shown in the photos is simple. Start by cutting a 1½-in.-thick board to the dimensions given in the materials list. The prototype was made of hardwood, although softwood works well, too.

On a radial-arm saw, set a dado head ¾-in. wide and at a 15° angle to cut ¾-in.-deep dadoes. Rotate workpiece and reset saw to 90° and the dado head for cutting the ¼-in. grooves, ¾ in. deep. A dado head on a table saw can also be used to cut the grooves and dadoes. Use marks at the edges of the base (A) to locate the cuts.

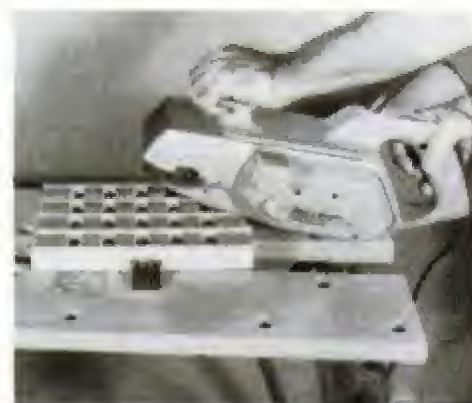
Now cut divider strips (C) slightly higher and longer than the grooves into which they are to be inserted. Also cut the sidepieces (B) slightly longer and higher than required. Apply glue, assemble and clamp. When the glue is dry, sand all surfaces flush for a good-looking project. The holder can be readily varnished, if desired, but a finish is not necessary.

Size your cutter selection board to suit your collection. If it's stored in a drawer, tack-fasten it to the drawer bottom to keep it from shifting around.—C.E. Banister

MATERIALS LIST—CUTTER STORAGE

Key	No.	Size and description
A	1	1½ x 5¼ x 9" hardwood
B	2	¾ x 1½ x 9½" hardwood
C	3	¾ x 1½ x 9½" hardwood

Misc.: White glue, polyurethane.



After dividers have been glued in place and have dried, sand away excess material.

Router depth gauge

This router cutter gauge makes depth setting accurate and rapid—and eliminates the chance of dulling the cutter bit from metal-to-metal contact when you're using steel rules or squares.

To begin, use a carbide-tipped blade to cut the laminate to the given dimensions. Cut a couple of extra pieces to allow for spoilage and practice drilling. Protect your eyes and face with a dust mask while working laminate.

Build the drilling jig by constructing a snug-fitting box from 3/4-in.-thick pine or plywood around the laminate pieces (A). The box should be about 1/4 in. higher than the stack. Glue and nail one end of the box in place; use screws at the other end.

Next, glue and nail the box to a 1 1/2-in.-thick base. The base, made from two 3/4-in. pieces of plywood, allows the spade bit to pass cleanly through the laminate pieces without running into the drill-press table. Size the base so it can be clamped to the drill-press table. Choose one piece of laminate for the top or guide piece and lay out hole centers for drilling. Prick-punch at the centers; then put 15 blank pieces in the jig and lay the guide piece on top. Set aside the 17th piece for use as the bottom (no holes) piece.

Use a 3/8- or 1-in. spade bit at medium speed to bore hole No. 1. Lift off the guide piece and remove the piece under it. Set the piece you just removed on top of the blank previously set aside. Replace the top guide piece and bore holes No. 1 and 2. Once again, remove the piece under the guide piece and set it down on the second pile. Don't disturb this

pile since it is in the proper sequence to glue the pieces. Repeat these steps until 16 pieces are bored, each with the appropriate number of holes (see drawing, far right). Remove all pieces from the jig after each hole is drilled to brush out the shavings and prevent sloppy bores.

To use the drilling jig as a gluing jig, unscrew one end of the box and put a shim at the other end. Slide in the drilled pieces and glue the side-

piece (C) to the exposed end. Remove the pile and complete gluing on the sides and ends. Compress and stack before gluing.—Robert Bessmer

MATERIALS LIST—DEPTH GAUGE

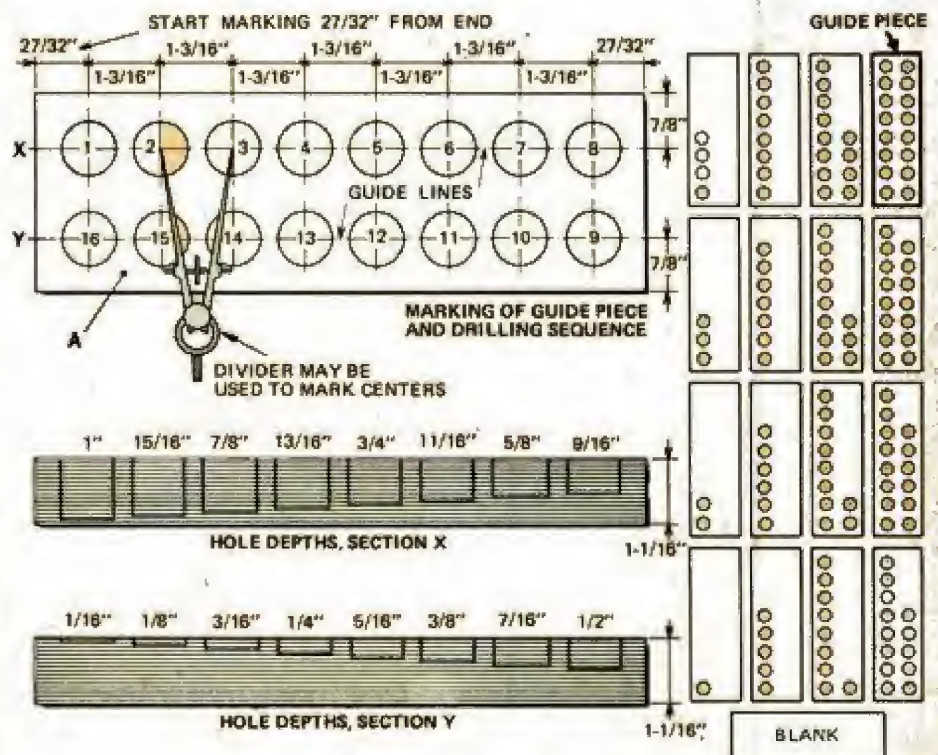
Key	No.	Size and description
A	17	1/8 x 3 1/4 x 10" plastic laminate
B	2	1/8 x 1 1/2 x 10" plastic laminate
C	2	1/8 x 1 1/8 x 3 1/2" plastic laminate

Misc.: Contact cement

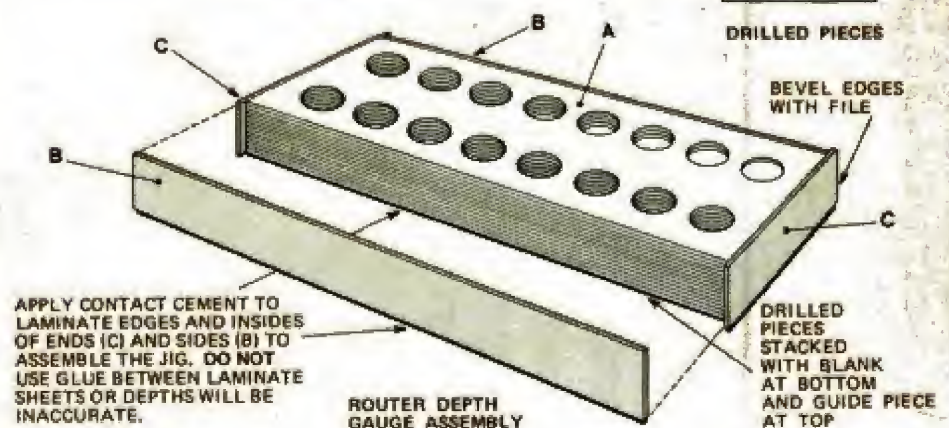
Note: To build the drilling and gluing jig, you'll need a few scrap pieces of 3/4" pine and fir plywood, 6d common nails, 4d finishing nails and white glue.



Label holes for quick and easy depth setting of pilotless router bits.



Plywood base, fastened to box which serves as drilling jig, is clamped to table.



Lathe compound-rest lock

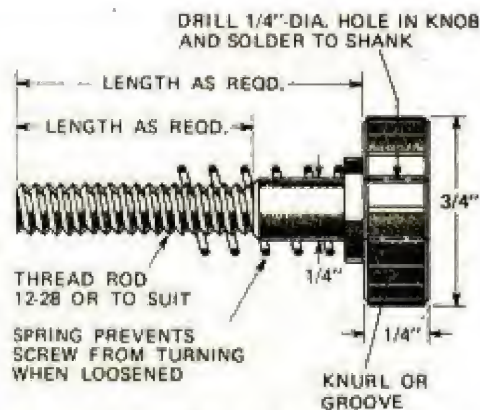
Sometimes, in lathe operations such as threading, it's desirable to keep the compound rest (which carries the toolpost) from moving, while in-and-out tool movement is controlled by the cross-feed screw. If the operator should bump

the compound-rest feed crank accidentally, the work could be damaged.

A gib screw sometimes is tightened to discourage the compound rest from moving, but this normally involves the inconvenient use of a



Knurled screwhead makes it convenient to lock the compound rest when required.

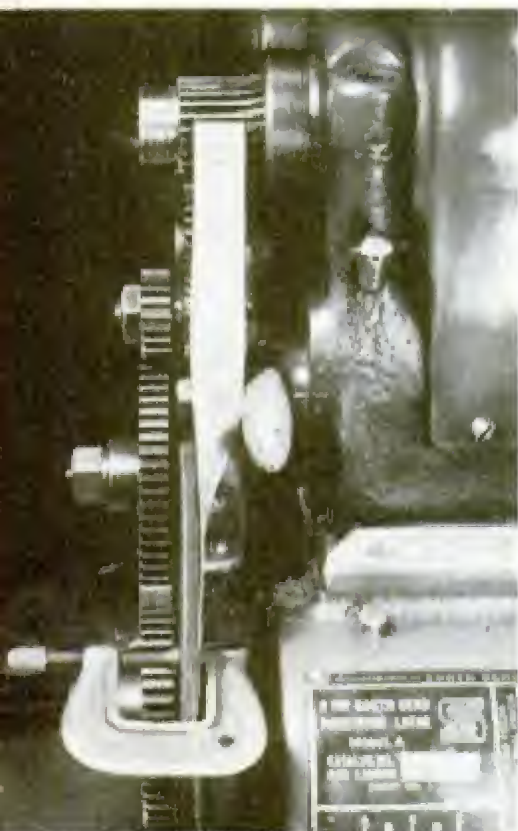


screwdriver. To make locking and unlocking operations easy and rapid, the knurled-head screw in the photo was made; it was designed for a 9-in. lathe. It has a 12-28 thread extending $\frac{3}{4}$ in.

Machine the threaded portion on the lathe from $\frac{1}{4}$ -in. brass rod. Make the grooved knob from $\frac{3}{4}$ -in. brass rod and drill a $\frac{1}{4}$ -in.-diameter hole in its center. Then solder the unthreaded (shank) end of the screw to the knob.

In use, the screw tip presses against the compound-slide gib to keep it from moving.

A coil compression spring was installed to help prevent the screw from turning when loosened, but perhaps it could be omitted.—Walter E. Burton



Aluminum "click strip" bears against the lathe-spindle gear teeth and converts the lathe into a handy indexing machine.

Simple lathe indexer

A simple way to provide for indexing operations on a lathe, as in cutting equally spaced grooves around the rim of a thumbscrew, is to clamp a metal strip so its tip presses against the gear teeth at the end of the headstock spindle. The (white) strip seen in the photo, about $\frac{3}{4}$ in. wide, was cut from scrap aluminum siding. It has enough springiness to keep it in contact with the gear. Bend the upper end of the strip so it will snap into spaces between the teeth when the spindle is turned backward by hand. Use a C-clamp to fasten the lower end to the gear-support plate.

To index, disengage the belt and any involved gears so the spindle can be turned freely, backward, by hand. Disconnect the motor power cord. Groove the workpiece (such as a thumbscrew head) with a pointed tool clamped on its side in the toolholder. Move the carriage back and forth along the bed, while controlling the cross feed so the tool makes a shallow cut, such as one-thousandth of an inch, at each pass.

The spindle gear on the lathe in the photo has 24 teeth. This permits a workpiece to be divided into 2, 3, 4, 6, 12 or 24 segments (or grooves). Equal spacing will depend on how accurately the "click strip" is positioned in each gear groove. A little practice can make the operation easier.

Accuracy is adequate for many jobs, such as making thumbscrews when a knurling tool is not available.—Walter E. Burton



Longitudinal grooves on the rim of thumbscrew were spaced with indexer at left.

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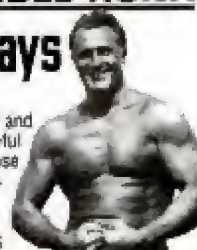
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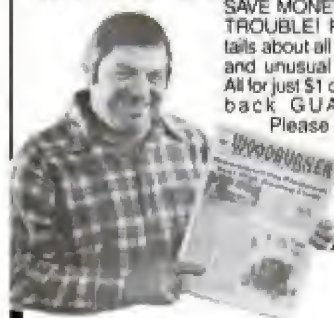
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As a boy in rural New York, I had grown up assuming that if you had a picnic, you roasted your hot dogs or hamburgers on a wood fire. Then, after I moved off the farm, I purchased a grill and adopted the habit of cooking over charcoal. As charcoal became harder to obtain, I tried using briquets. They produced a hotter fire and the coals lasted longer, but they were expensive, slower to ignite, and left huge piles of ashes to be disposed of.

It seemed as though there must be a better way. I decided to try cutting seasoned hardwood into small pieces, similar in size to briquets, and using them for fuel. In short, I found that hot dogs, hamburgers, steaks and fish were all easier to cook and better tasting when broiled over a wood fire.

If you want to try barbecuing over wood, I have several suggestions. First, use seasoned hardwood either from the shop scrap pile or from the woodpile. The easiest way to cut up scrap is on a table saw. When cutting firewood, select a large-diameter log and slice it into 3- or 4-in.-thick discs. Then split it with a hatchet or wedge and hand maul into blocks.

Make sure not to use softwood, except for kindling. It doesn't give lasting coals and the pitch content gives an undesirable flavor to grilled foods.

There are advantages to barbecuing over wood. First, it takes less time to get a fire ready than when using charcoal or briquets. It's also

easier to judge when the fire is right for cooking. You will, however, have to build a much larger fire than with charcoal. Leave the cooking grid off and build the fire up in a pyramid shape. As the blocks catch fire, put more on immediately. After the blocks are all flaming, spread them out. Then start cooking your food as soon as the flames subside.—Warren H. Giles



Use a chain saw to slice up a hardwood log into 3-in.-thick discs. Then, with a hatchet, split discs into blocks of equal width.



When flames die down, spread hot coals and begin cooking immediately. The heat doesn't last as long as that of mineral fuels.

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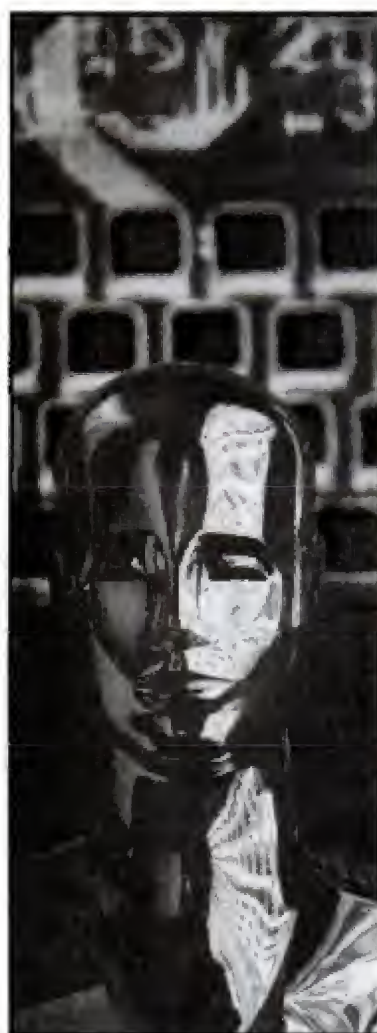
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TAMING GIANT TWISTERS

(Continued from page 67)

floor and powered it with a variable-speed d.c. motor capable of rotating the frame on its bearings from 1 to 11 rpm. They wrapped a fine mesh around the frame, creating a cylindrical screen that looks like a giant beekeeper's bonnet.

The space above the "bonnet" is enclosed in a sheet-metal cylinder. In an attic over the apparatus, the Purdue technicians mounted a blower capable of drawing air through a hole in the ceiling.

Snow explained how the simulator mimicked the real thing. To start with, researchers rotate the "bonnet" slowly as air passes through its wire mesh from all sides. This movement of air at the base of the simulator matches the counterclockwise wind rotation that accompanies the large, low-pressure systems moving west to east in the United States each spring. When air to the east of the warm front is unusually warm and moist, collisions with a cold front can generate thunderstorms.

A glancing blow

Within the thunderstorm itself, rain pulls cold air to the surface. This blanket of dense air thrusts warm, lighter air upward. The collision between warm and cold air within the thunderstorm is not head-on; instead, the cold air is traveling south or southeast, the warm air north or northwest when they meet in the storm. The result is the kind of spin you might expect to see if cars collided at an angle.

But in this case, after the glancing blow as fronts collide, the warm air spins upward. In the simulator, the overhead blower creates the up-draft, pulling spinning air into neat miniature tornadoes 6 or 7 feet tall.

As Snow turns on the blower and starts the screen rotating, he also flips on a bank of spotlights inside the tornado generator. In nature, condensed water vapor or "cloud material" and swept-up dust and debris make tornadoes visible. At Purdue, Snow injects smoke at the very bottom of the lower chamber.

Within seconds after the gentle snake of smoke climbs up to the hidden blower, it snaps stiffly to attention and starts swirling inside the chamber. It's already a full-blown tornado. Seconds later, the snake grows stronger, beginning to twist and dance around the chamber like the twister that hit Kansas in *The Wizard of Oz*.

Soon the snake seems ready to give up, swelling slowly from the top

down, until a bloated column of smoke remains. But it's just cloning, like the tornado photographed by Wally Hubbard. Soon two snakes dart out of the column, dancing around each other. Then a third appears, and a fourth.

Before John Snow could customize tornadoes in his lab, researchers like him were limited. They could conduct detective-like investigations after tornadoes struck. Or they could guess when and where one would hit, then hurry there to make on-the-site observations; a lucky scientist might observe just two tornadoes during the summer storm season because forecasting methods are so imprecise. Currently there just isn't enough warning time for scientists who want to chase tornadoes—or for local residents who want to evade them.

No warning in Round Rock

The only warning to the town of Round Rock, Tex., clacked over a teletype in the police station at 3:00 p.m. on April 7. But the message said nothing of tornadoes. The news was that hail and heavy rain were falling about 30 miles to the west. Around 4:30 p.m., Chief Gene Collier stationed himself on a hill north of his town to watch the western sky.

He knew as soon as he saw the approaching cloud that it was no ordinary thunderstorm. "It was a small, white whirling cloud," he told us. It crossed the town line, then arched like a claw to the roof of Murffys Nursery.

Mike Robinson at the nursery was even less prepared for what happened than Chief Collier. "I've always heard it gets quiet before a tornado, but that's bullcrap," he told us. Just before the "cloud" struck, about 4:50, wind howled. "We have a big tin barn and it hailed on one end, stopped and hailed on the other. Then it started raining real hard. I went out to move some tomatoes under some shade cloth because of the hail. Then I looked up and saw some lumber flying up in the air, pieces of firewood, two-by-fours. Apparently I looked up just as it started to hit the building." Three seconds later it was gone—along with half of the tin roof covering the 120-foot-long building. Again, the tornado displayed a perverse personality. The winds picked up about 50 packages of herb seeds, blew them five miles away and scattered them like a drunken planter on the lawn of one of Robinson's friends.

A better warning system would not prevent such damage, of course, but it might save lives by allowing

(Please turn to page 118)

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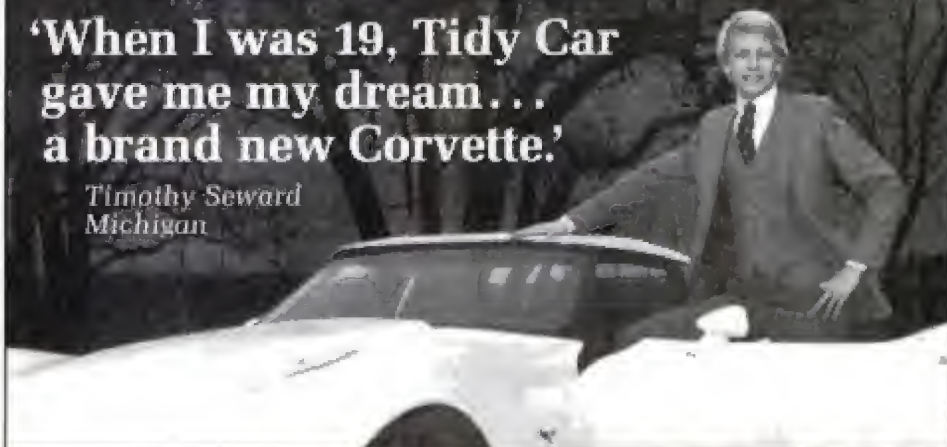
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TAMING GIANT TWISTERS

(Continued from page 117)

people time to take cover. Robinson, who faced the twister outside, was lucky to have escaped injury.

Two technological breakthroughs should help weather experts spot conditions preceding a tornado, and sound warnings earlier.

One breakthrough is an infrared atmospheric probing system called VAS, an acronym for Visual and infrared spin-scan radiometer Atmospheric Sounder. "Comparing existing forecast methods to VAS is like comparing an Instamatic snapshot to a professional motion picture," said Dr. Fred Mosher, manager of the VAS program.

A satellite launched this summer will hang south of Kansas City and scan the atmosphere at 12 infrared frequencies. Each frequency penetrates different distances through the atmosphere, so computers will be able to display data at three-mile bands from the ground to 36 miles over the earth. Forecasters will be able to watch storms as they develop, pinpointing thunderstorms accurately. But which thunderstorms will spawn tornadoes?

Doppler radar may answer that question. At the Norman, Okla., National Severe Storms Laboratory, technicians have developed a Doppler radar system that uses the same principle behind speed-trap radar units to measure wind velocities inside thunderclouds. Winds moving toward the radar station are displayed on a computer screen as green blips, and winds moving away as red blips. The greater the wind force, the brighter the colors.

If a forecaster spots a bright green blip next to a bright red blip, it means a tornado is probably imminent. Early tests with the Doppler radar have provided 30-minute advance warnings of tornadoes.

Doppler radar and VAS will enhance forecasting and provide early warnings, perhaps by 1990. In the meantime, scientists are at work on a third front: trying to avoid the death and destruction caused every summer by tornadoes.

Wind-tunnel test for houses

Until recently, most of the investigation into how and why tornadoes collapse buildings and injure or kill the occupants has been done at the University of Kansas by Prof. Joe Eagleman and colleagues. In the wake of major tornadoes, Eagleman studies injuries to both buildings and people. A natural-born tinkerer, Eagleman has also built dozens of scale-model homes from popular

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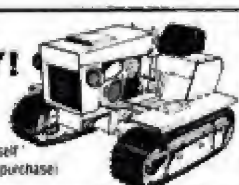
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standard designs and put them in wind tunnels. While he knows that very few buildings of ordinary construction will withstand a direct hit by a major tornado, he's also seen that two-thirds of the seriously damaged buildings are not hit directly.

Eagleman blames builders and building code authors. Most building codes, calling for protection against 70-mph winds, are inadequate, Eagleman asserts. He finds that builders expect gravity to hold roofs on top of walls, which works fine except when a nearby tornado vacuums up the tops of homes and collapses walls. He's convinced that homes could safely withstand 200-mph winds if all that expensive lumber weren't fastened together so poorly. (See *Protection From Wind*—for \$85, page 66).

Studies Eagleman has conducted also show that the southwest corner of the house—once suggested as the place to go to escape injury—is *the most dangerous place* to be. That's where tumbling and flying debris lands most often. The north and east, he reports, are safest.

Other survival strategies

Other suggestions for survival arose from a study of the destruction and death caused by a severe tornado that struck Wichita Falls, Tex., in 1979. Forty-seven died.

Researchers from the federal Center for Disease Control and elsewhere analyzed the deaths to assess existing recommendations about what to do in a tornado. Their major finding: It's dangerous to be in a car or mobile home when tornadoes hit. Some 60 percent of those killed immediately were people who had run to their cars to drive out of the storm's path. People in mobile homes were at greatest risk of serious or fatal injury. The researchers' recommendations:

- If you're in a motor vehicle, seek shelter as soon as you hear a tornado warning. Don't try to drive from the tornado's path.

- If you live in a tornado-prone area, you should identify and reinforce some interior portion of your home as a shelter.

- Mobile home communities should offer shelters to residents.

As frightening as tornadoes are, the report did contain some reassurance for homeowners: If a twister scores a direct hit while you're inside your house, the chance of suffering a fatal injury is only about one in a thousand. And the tornado research now underway is likely to further enhance the safety of your home, even if it's struck by one of nature's most frightening killers. **PM**

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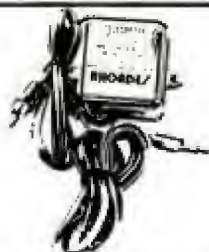


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CAMP-CRUIISING BY KAYAK

(Continued from page 75)

with air-filled side sponsons, there is little likelihood of capsizing it, but cargo bags, spotlights, sleeping bags and camera cases should be pretested for waterproof quality. Then attach them to the kayak with $\frac{1}{8}$ -inch nylon lines to prevent loss. During an emergency, they can also provide added buoyancy. As a precaution, cargo bags may be lined with three-mil plastic garbage bags tied off with rubber bands. Life preservers are required equipment. The necessary bailing bucket



Mitey Brush anchor for tossing ashore hangs on gunwale; a tackle box and kit bags are tied or held in place with Velcro.



For photos en route, Haddon mounts tripod with one leg through mast socket and rubber tube with bulb extended to paddler.



Cut the bottom off a plastic bleach bottle to make a bailing scoop that can be tied to a gunwale with $\frac{1}{8}$ -inch nylon line.



Duffel bags, sleeping bag, spotlight and all "waterproof" and "floatable" items should be tested, then secured to boat.



Handy shelf of $\frac{1}{4}$ -inch plywood makes a mini-table for lunches, brace for telephoto shots, tent table ashore or base for stove.



Compass, wind-speed indicator, waterproof match container, waterproof bag are items to Velcro-mount or tie in cockpit.

can be made from a Clorox container or similar plastic bottle with its bottom sliced off. Flexible and more attractively shaped than a bailing can, it has a built-in handle and conforms to the contours of your craft.

For kayakers who travel along steep, rocky shores, a 20-ounce Mitey Brush anchor can be useful. Tossed into shoreline bushes or among rocks, its 50 feet of $\frac{1}{8}$ -inch nylon line holds the hull firmly against the shore for easy stepping out. Metal points on this anchor are flexible enough to permit yanking it free if necessary.

I also use a Klepper inflatable camera bag for flotation and cushioning. A pocketable Dwyer wind-velocity meter is another useful accessory.

I simplify photography aboard by an-



Using a free-standing Jansport lightweight dome tent that's big enough for two, Heddon camps alone, fitted out for comfort.

choring my tripod in the mast step with a bungee cord. The camera is snapped with an air tube and bulb taped to the floor where I can push it with one foot. By pre-focusing, I can record anything from scenics to fish being landed.

A motorized camera would allow you to take shots in sequence without having to lean forward in order to advance the film. A built-in automatic exposure control would be helpful.

A versatile table

My simple kayak table has proved its worth for everything from brunching to steadying elbows while using telescopic lenses or 16-power binoculars. It's a piece of enameled, 1/4-inch plywood with blocks below to keep it from shifting sideways. It can slide fore and aft along the gunwales.

In stormy weather while ashore in the tent, it serves as a table or base for the butane cookstove.

Personalized equipment

Customizing means fitting out and installing aids and equipment that are selected and positioned just right for you. Velcro tabs, shock and bungee elastic cord, oversize rubber bands slit from discarded inner tubes and nylon line are good for securing accessories. Nylon cord, like the surplus type used for static lines of parachutes, will lash gear in place, but still untie easily, as a rule, when the knots get wet. Make good use of the line for lanyards on items like your bail scoop, searchlight and inflatable cushion, as well as cargo duffel. A pull on a color-coded line from your paddling position can bring your bailer quickly to hand without your leaving your seat. The tie-lines keep gear from floating away after an unlikely capsizing.

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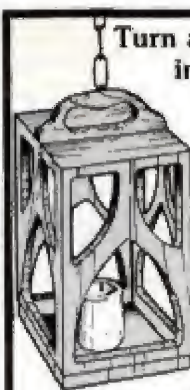
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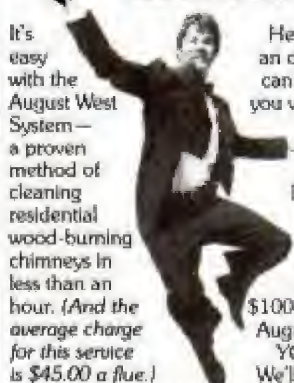


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—Walter E. Burton

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NEW OUTDOOR GEAR

(Continued from page 76)

in its fine rust-resistant qualities.

Look to graphite, boron and magnesium, combined with fiberglass, to provide more strength, lightness and sensitivity in fishing rods. Check the percentage included, however, since trace amounts are sometimes included only as a sales gimmick, while 100 percent allows for no binding agent.

While you're backpacking, ounces may start to feel like pounds along



For fish with finicky appetites, anglers can assemble pattern-switching lures with Create-A-Lure's "quick change" spoon kit.

the trail. Hiking has inspired the search for gear that's lighter and stronger. Tough duffel of Cordura doesn't have the weight or bulk of heavy canvas but lasts longer. Synthetic fabrics like nylon can be treated with synthetic products like Teflon to produce cloth like Gore-Tex or Klimate. On tents and garments, such cloth lets sweat vapor evaporate but keeps out rain. Polyester insulation nearly matches down in lightweight fluffiness for loft in sleeping bags and jackets, and more than surpasses it in washability, warmth when wet, and ease of fabrication.

Afloat, less weight in a boat hull can add miles per hour without increasing power, or can cut fuel consumption. Aluminum and inflatable boats reduce weight. Some fiberglass-reinforced plastic craft are substituting Kevlar aramid fibers for a portion of the glass. Similar to bulletproof-vest material, the plastic product has a high strength-to-weight ratio and can lighten a boat without weakening it. Plastics are appearing as marine hardware, sails and lines, as well, and can resist the ravages of salt spray with less maintenance.

So far, the new compounds can add considerably to cost. But the hope is that increased production will make them less expensive, and that would be an extra bonus. **PM**



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ROBOTS YOU CAN BUILD TODAY

(Continued from page 17)

less interface and software (programming aids). Initial software exists for the KIM-1 and soon will be available for DEC and Radio Shack computers (see addresses at the end of this article).

Robot by mail

Mentor VI is a boxy-looking robot presently undergoing final design. Like its predecessors, it will come piece by piece with an International Institute of Robotics correspondence course (starting with basic electronics, expected to cost around \$990).

Mentor VI will be about 4½ feet high with an upended-box body, a box head and two legs on wheels. The movable head is planned to carry "sonar" and a stereoptical scanner.

Dale Cowser's International Institute of Robotics, a nonprofit organization, publishes *Robotics Newsletter*.

Make a 'Mike'

Scratch building may save some cost, but expect to spend all your spare hours over two to six months. You can use common shop tools for the most part, but some specialized equipment may be necessary.

Mike, a robot you can build from plans in a book, has ribbon switches on each of eight sides for impact sensing. Ultrasonic sonar detects obstacles up to 10 feet ahead. The 14-inch-high, 27-inch-wide, three-wheeled structure can carry 600 pounds. A "voice recognition" system is detailed, whereby Mike's program can be overridden by words or whistles.

Music over matter

Author Frank Da Costa's Lek-tranimal is, in some ways, simpler than Mike—certainly smaller and lighter, but without Mike's room for expansion. You build its "brain," but only deal with a limited device, not a general-purpose computer.

About 1 foot tall, 1½ feet long and 6 inches wide on three wheels, it is an apartment-sized robot "pet." Front/left/right sonar is used. Its microcomputer has an 8085A "brain" and operates on a skimpy 512 or 768 bytes of memory. (A byte is memory storage space for one letter or two numerals.)

Programming randomizes behavior by, in effect, continuously "flipping an eight-sided coin" to choose among eight tasks. One is "bark"—actually "more like 'warp,'" says Da Costa, which "drives my parakeet

crazy." Some tasks are commanded externally through circuitry, interpreting groups of five musical pitches from voice or instrument (or perhaps vengeful parakeets?).

Cost is about \$250 to \$300, of which the "brain board" is only \$70 to \$75.

What's Newt?

Probably the closest thing to R2D2 is Ralph Hollis's cylindrical Newt, a one-of-a-kind widely considered to lead the hobbyist field. It has been several years in development, isn't finished yet and already has cost over \$600, not counting 100-plus custom-machined parts.

An R2D2-like "sensory turret" will revolve 360° atop Newt with several light, optical, sound and infrared sensors. The manipulator has its own optical scanner.

Programming employs highly advanced "propositional" computer language and takes about 32 kilobytes (32,768 bytes) total memory. And, Newt still won't do housework and will never outwit his owner!

Robot gets smart

David Heiserman's Rodney is the closest thing to Newt available in book-plans, although it presently lacks manipulator and turret.

Rodney recharges itself whenever bumping across its "nest." Rather than directly detecting obstacles, it senses when either of its drive motors has stalled. (Most robots grind away if parts other than impact sensors touch objects first.)

The 8085A-based computer you build is programmed to remember past encounters with obstacles, and then to provide generalized responses to new situations. That is, Rodney learns—a big step in artificial intelligence. Rodney (and Buster) materials are estimated to cost under \$400.

Et-2, Robotus?

Lour Sales Group's et-2 three-wheeled, polyvinylchloride (PVC) robot chassis is for experimenters able to install a computer of their own and originate all programming. Cylindrical and 20 inches tall, it includes two empty shelves, drive motors, bumper sensors, battery mount and associated electronics. An optional manipulator should be available soon. The complete et-2 is \$495; kits, \$375; superb plans, \$15.

A similar idea was the Grivet robot base module by Gallaher Research Inc. Kits, plans, parts and manipulators, widely publicized un-

til late 1979, may continue to be produced under new ownership soon.

Simulated robots

Heiserman (Rodney's designer) says your best first robot might be no robot at all. Instead of the "expense and trouble of building," he suggests computer simulation and has two related texts in preparation for TAB Books.

This way, your existing home computer can run robot programs. The video monitor shows a robot exploring a room, appearing much like a TV game. Or you can depict just one part, maybe a manipulator, to study its function.

A robot 4U2?

Outside a hobbyist robotics seminar at the 1979 National Computer Show in New York City, 18-year-old Holden Caine had his own creation on display. Occasionally, hip-high Herb slipped quietly into the crowd when Caine wasn't watching.

Herb's development now continues its existence at a college Caine selected for its facilities to help. For him and many others, robots aren't science fiction, but an everyday part of life.

Could it be time for the "roller-rolling of little wheels" in your home, too? **PM**

Where to obtain further information

Assembled robots, kits, parts

Gallagher Research Inc., Box 10767, Winston-Salem, N.C. 27108 (response may be delayed).
International Institute of Robotics, Box 615, Pelahatchie, Miss. 39145.
Lour Sales Group, 1822 Largo Ct., Schaumburg, Ill. 60194 (send 50 cents for information).
Terapin Inc., 33 Edinborough St., Boston, Mass. 02111 (send \$1 for information).

Plan books

"Buster" by Heiserman, *Build Your Own Working Robot*, \$5.95, TAB Books, Blue Ridge Summit, Pa. 17214.
"Lektranimal" by Da Costa, *How to Build Your Own Working Robot Pet*, \$6.95, TAB Books (see address above).
"Mike" by Loofbaumow, *How to Build a Computer-Controlled Robot*, \$7.95, Hayden Book Co. Inc., 50 Essex St., Rochelle Park, N.J. 07662.
"Rodney" by Heiserman, *Build Your Own Self-Programming Robot*, \$7.95, TAB Books (see address above.)

General books

The Complete Handbook of Robotics, by Safford, \$7.95, TAB Books (surveys concepts).
Robots: Fact, Fiction and Prediction, by Reichardt, \$8.95, Penguin Books, 625 Madison Ave., New York, N.Y. 10022 (general overview).
Robots on Your Doorstep, by Winkless & Browning, \$7.45, Dillithium Press, Box 92, Forest Grove, Ore. 97116 (unusual commentary).
Simulation, \$6.60, Byte Books, 70 Main St., Peterborough, N.H. 03458.

Magazines

Byte (\$18 for 12 issues; many robotics articles), 70 Main St., Peterborough, N.H. 03458.
Interface Age (annual April robotics issue), 13913 Artesia Blvd., Cerritos, Calif. 90701.
Robotics Age (\$7.50 for four issues; new, to include U.S. Robotics Society News), Box 4029, Houston, Tex. 77210.
IIR Robotics Newsletter (\$8 for 12 issues), Box 615, Pelahatchie, Miss. 39145.

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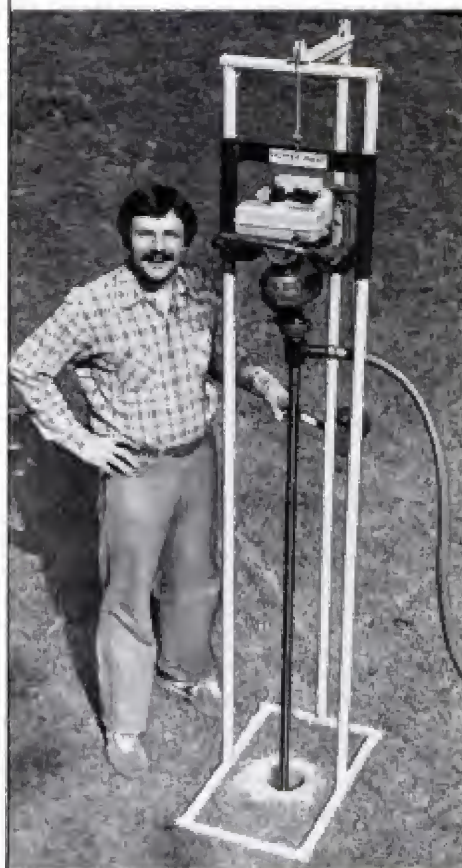
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DRIVING THE AUDI 4000 (Continued from page 37)

twisty, two-lane roads in the mountains of western North Carolina, and what a lively, agile mountain goat it was! The turbo package offers a special performance suspension, wide, low-profile steel radial tires on snazzy, 15-inch, spoked alloy wheels, power rack-and-pinion steering and power four-wheel disc brakes. It all works beautifully to



The 5000's cockpit provides full instrumentation and a first-class environment. It is available only with an automatic.

make the car go, stop and corner like a thoroughbred.

The Turbo is a finely tuned, spirited sports car disguised as a luxury sedan. Our only regret is that the turbo engine comes with automatic only; you can't get it with Audi's new five-speed manual transmission.

Inside the quiet and comfortable cabin, cradled by the excellent, form-fitting bucket seats with infinitely adjustable backrests, you're treated to a fully instrumented panel which includes tachometer, vacuum/boost and oil-temperature gauges, all easily visible through the Turbo's special four-spoke steering wheel. Controls for wipers, lights, turn signals and the standard cruise control are on handy steering-column stalks. There's a storage tray under the dash and a bin on the console (whose top cover doubles as a beverage tray for rear-seat passengers). A sharp-looking digital electronic clock glows from its perch between the sun visors.

Additional standard equipment includes an aerodynamic front air dam under the bumper, power windows and door locks, airconditioning, tinted glass, four-speaker stereo radio with cassette player and automatic power antenna, dual remote-control outside mirrors, a lighted vanity mirror, intermittent wipers, electric rear-window defogger and much more. The only options are leather and/or heated seats, a power sunroof, metallic paint and power outside mirror adjusters.

There's also a lot more under the stylish body to separate the Turbo from the "ordinary" 5000. The engine pistons are cooled from the bottom by a fine oil spray, a system similar to that in the Mercedes-Benz 300SD. Exhaust valves are sodium-filled, with an engine oil cooler and a separate oil system and filter just for the turbocharger. Larger driveshafts and special forged spindles carry the Turbo's 30 extra hp to its front drive wheels. Yet maintenance is no different from that for the normal 5000, since the turbo unit itself is maintenance-free. If turbo trouble does arise, Porsche+Audi dealers are already experienced with turbocharged Porsche engines, so they should be able to handle the Audi system.

When Audi engineers decided to make an automatic transmission available in the 4000 coupe and sedan, they felt its standard four-cylinder engine would be a bit too sluggish, so they simply adapted the 5000's five-cylinder engine/automatic package to fit. The result is pleasingly snappy performance (0 to 60 in 13 seconds) combined with reasonable (20-plus mpg) fuel economy. And—good news for manual shifters—there will be a five-cylinder, five-speed version later.

We've covered the 4000 in previous issues (*Firsthand Report: Driv-*



The 4000's interior is leaner, but by no means Spartan. A five-speed manual transmission will be available in near future.

ing the Audi 4000, page 32, June '79) so suffice it to say the car has the look and pleasant character of its larger brother in a slightly smaller, less plush and less expensive package. A power assist for the rack-and-pinion steering and a tachometer come with the automatic, in addition to the standard 4000's equipment. The option list includes airconditioning, stereo radio (with or without cassette player and power antenna), manual sunroof, cruise control, alloy wheels (13-inch or spoked 14-inchers with low-profile tires), power door locks, right outside mirror, metallic paint and a driver's seat-height adjustment. **PM**

CAMERAS FOR THE DEEP

(Continued from page 85)

where other cameras must be kept in their cases.

PM tried these cameras recently above and below water. Aside from the Eumig's stiff zooming (due to water sealing), both units were about as easy to use as their dry cousins. They weigh slightly more than dry cameras with similar features, but both float. Each relies on an O-ring to seal out water; the Nautica's needs occasional lubrication.

We weren't able to test the Eumig down to 115 feet, but we put both cameras through their paces for several hours to a depth of 8 feet. After lots of splashing and swimming we can report that nary a drop of water found its way inside either unit.

Underwater picture-taking takes practice, but our biggest problem had nothing to do with the cameras; we just kept running out of air. Using a snorkel and staying near the surface should solve that.

Under water, framing the shot with either camera is harder than on land, especially with a mask. Eumig's accessory sportsfinder makes it easier; Minolta offers one as a \$9-list option.

Our testers generally liked both cameras. The Weathermatic was praised for its built-in flash, and its oversized controls eased handling. One staffer preferred a movable cover to protect the lens and flash.

On the Nautica, the backlight compensation knob was appreciated. Stiff zooming of the 9- to 30-mm f/1.9 lens was a drawback, as was the loss of zooming under water.

Although both cameras appear quite rugged, they can still be abused. Minolta recommends that the Weathermatic not be subjected to extreme heat (as on sun-baked sand or in a glove compartment), and of course it can't be indiscriminately dropped. The Nautica's lens is as susceptible to scratching as other lenses. Both cameras should be rinsed off thoroughly after exposure to salt or chlorinated water.

Given the limitations of the 110 format, the Weathermatic could easily function as an all-around camera. The Nautica, while not as feature-packed as other Super-8 units, brings a new dimension to home movies. Don't be surprised if other manufacturers follow the lead of these two companies. The A after Weathermatic may imply B and C models from Minolta, too.

Weathermatic-A lists for \$160, the Nautica, \$500; both will probably be available at a discount.

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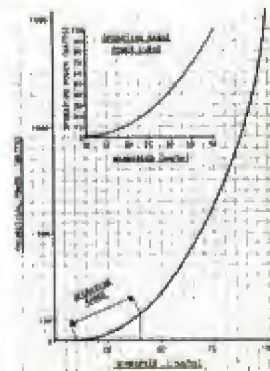
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The solution turned out to be simplicity itself! Everybody knew that the torque characteristic of a Savonius rotor could be improved - at some cost - by stacking two or more phase-shifted rotor segments. Three is better than two, four is better than three. Thermax engineers then reasoned that the ideal torque output would theoretically be achieved by stacking an infinite number of such rotor segments, and so they invented the "Helius" rotor. The 90-degree twist of the vanes gives this rotor a completely smooth output torque. The problem was solved, and a new type of rotor had been born!

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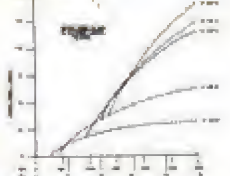
They told us that nobody would ever want to own a small windpower system, less than kilowatt size. But renewable energy enthusiasts and educators kept asking us for a simple and inexpensive wind generator power for a weekend cottage, RVs, electric fences, battery charging and many other uses. Now our customers tell us the TC25 Helius Rotor is "exactly what we were looking for"—they proved the experts wrong again!

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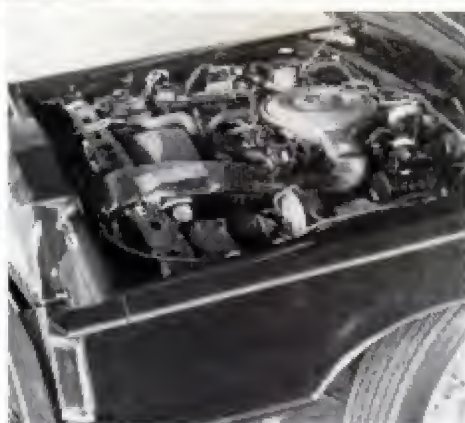
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watch all those green bars rise and fall and the numbers flash up and down. Also, I understand there are 315 circuits in this dashboard, which could be a nightmare to repair. I'm not ready for the space age yet!"

But the area of most complaint centered on the Mark's new overdrive automatic transmission. In light-throttle driving, it shifts to fourth at about 35 mph. It also shifts out of fourth at that speed, which means that around town it's continuously hunting and pecking between third and fourth gears. Many owners found this annoying, and 34.2 percent reported taking their cars back to their dealers for a cure. There is no cure, of course, except to leave the transmission selector in third range for in-city driving and then shifting manually to fourth on the open road.

"I wish they'd eliminate the overdrive automatic entirely," sighed a Michigan businessman, who added that, "... when trying to pass another vehicle on the highway, you'd best have a lot of room and time."

"The overdrive automatic has a jerky motion," reiterated a Tennessee contractor, and an Iowa clothing merchant grumbled, "Overdrive not smooth." General Motors is experiencing similar complaints



Most owners chose 5.8-liter V8 engine. They found it yielded 18.1 mpg on highway.

with its torque-converter lockup. So it's not a problem unique to Ford.

On the topic of quality control, 60.6 percent of our respondents graded workmanship *good to excellent*. That's not a glowing mark; in fact, it's 14 percentage points below the 1980 Cadillac Seville, which also won no prizes in the workmanship department.

A good many of the economy imports have scored in the high 90s in recent PM Owners Reports—cars like the VW Rabbit, Toyota Tercel, Mazda 626 and others

that cost half to a third what a new Lincoln or Cadillac does.

Nor did dealer service win much praise from Mark VI owners. Of those surveyed, 43.6 percent rated it *average to poor*. And 65.1 percent reported mechanical problems of some sort, which means most owners got the opportunity to test dealer service.

"I'm unhappy about the three trips I had to make to the dealer to repair the automatic enrichment device on the fuel-injection system," complained a Minnesota apartment-building owner.

An Arizona retiree whose electronics wouldn't let him open the doors or trunk griped, "I bought a \$20,000 car, and they can't get the computer parts for it!"

And a California accountant moaned, "Oil leaks out on the garage floor, and the engine smokes after I shut it down. I've had the car in three times for the cruise control and had to put in four quarts of oil in the first 5000 miles. The dealer just can't get the little things fixed."

But even despite these and more minor complaints, most Mark VI owners wouldn't trade their cars for anything else, and most would buy another Lincoln.

"Yes, I wouldn't change. This is by far the quietest automobile I've ever owned,"

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said a Tennessee real-estate broker. "Yes, I consider the Lincoln a much better automobile than the Cadillac"—Illinois funeral director.

"Yes, especially since our first Lincoln was a 1938 Zephyr V-12 and we've been driving Lincolns ever since. Too late to change now!"—Retired California photographer.

A New York banker put it this way: "The Mark is the ultimate statement of what the American luxury car is all about. It provides unparalleled comfort and a great ride. And now, with the smaller engine, the fuel economy is also good."

"Yes, I'd certainly buy another," rhapsodized a Texas secondary-school teacher, "because the Mark series Lin-

colns don't need to be sold. They sell themselves. We have owned one of each since the Mark III in 1968."

She sums up her own response and that of many owners this way: "Here's a car with distinctive appearance, a new economical design, deluxe appointments, fine driveability, and a superb ride. It's a totally great car!" **FM**

Summary of 1980 Lincoln Continental Mark VI Owners Reports*

Total miles driven 1,156,952	Handling..... 32.1	Good..... 12.1	Average..... 21.1
	Ride..... 28.8	Fair..... 1.7	Fair..... 9.3
	Economy..... 17.7	Poor..... 1.3	Poor..... 13.2
Average miles per gallon	Specific dislikes:	Comfort opinion (rear seats):	Number of vehicles owned:
5.0-liter V8	No complaints..... 20.4%	Excellent..... 41.0%	Mark VI only..... 29.7%
In town..... 14.0	Lower-than-expected mileage..... 18.4	Very good..... 30.6	Two cars..... 49.1
Long trips..... 18.9	Workmanship..... 13.4	Good..... 19.5	Three cars..... 13.4
5.8-liter V8	Transmission..... 9.5	Fair..... 4.6	Four or more cars..... 7.8
In town..... 13.6	Poor dealer service..... 8.5	Poor..... 4.1	
Long trips..... 18.1			
Engine choices:	What changes would you like?	Had any mechanical trouble?	Makes of other cars owned:
5.0-liter V8..... 18.1%	No changes..... 21.8%	Yes..... 65.1%	Ford..... 26.3%
5.8-liter V8..... 81.9	Better materials..... 15.4	No..... 34.9	Chevrolet..... 19.4
	Better fuel mileage..... 11.2		Lincoln..... 16.9
Body-style choices:	Smother transmission..... 6.9	What type of trouble?	Mercury..... 15.6
Two-door sedan..... 59.5%	Better workmanship..... 5.9	Transmission..... 34.2%	Cadillac..... 12.5
Four-door sedan..... 40.5		Carburetor..... 16.4	
Why did you choose the Mark VI?	Workmanship opinion:	Electrical..... 15.1	Age distribution of owners:
Styling..... 47.3%	Excellent..... 30.3%	Smog system..... 8.9	15-29 years..... 3.3%
Owned Lincolns before..... 35.1	Good..... 30.3	On-board computer..... 6.6	30-49 years..... 37.4
Economy..... 10.4	Average..... 17.3		50-plus..... 59.5
Comfort..... 7.2	Fair..... 11.7	Dealer repairs satisfactory?	
Size..... 7.2	Poor..... 10.4	Yes..... 57.1%	Would you buy another Lincoln?
		No..... 42.9	Yes..... 77.8%
Specific likes:	Comfort opinion (front seats):	Dealer service opinion:	No..... 22.1
Styling..... 53.0%	Excellent..... 58.2%	Excellent..... 27.8%	Would you buy another Mark VI?
Comfort..... 32.6	Very good..... 26.7	Good..... 28.6	Yes..... 78.4%
			No..... 23.6

*Percentages might not equal 100% due to rounding or insufficient data.

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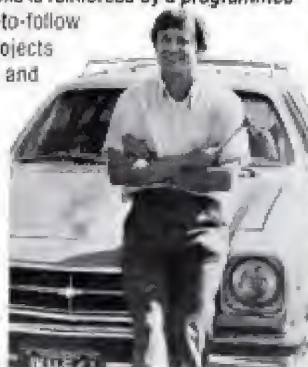
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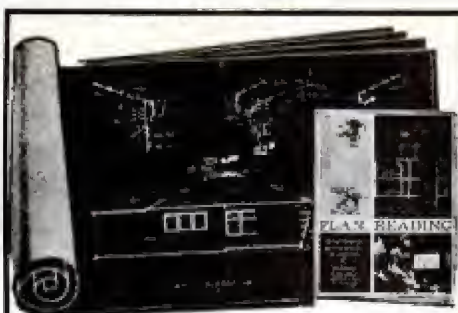
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Barbecue in a 'well'

This "well-made" barbecue with a roof lets you cook out on rainy days and has a grill that's infinitely adjustable. After choosing an appropriate site for the barbecue, pour the circular-slab footing and let it set. A ring-shaped footing can also be poured to save concrete. Make the trench 10 in. wide.



Although it looks like a well, it's really a large-capacity barbecue with a roof.

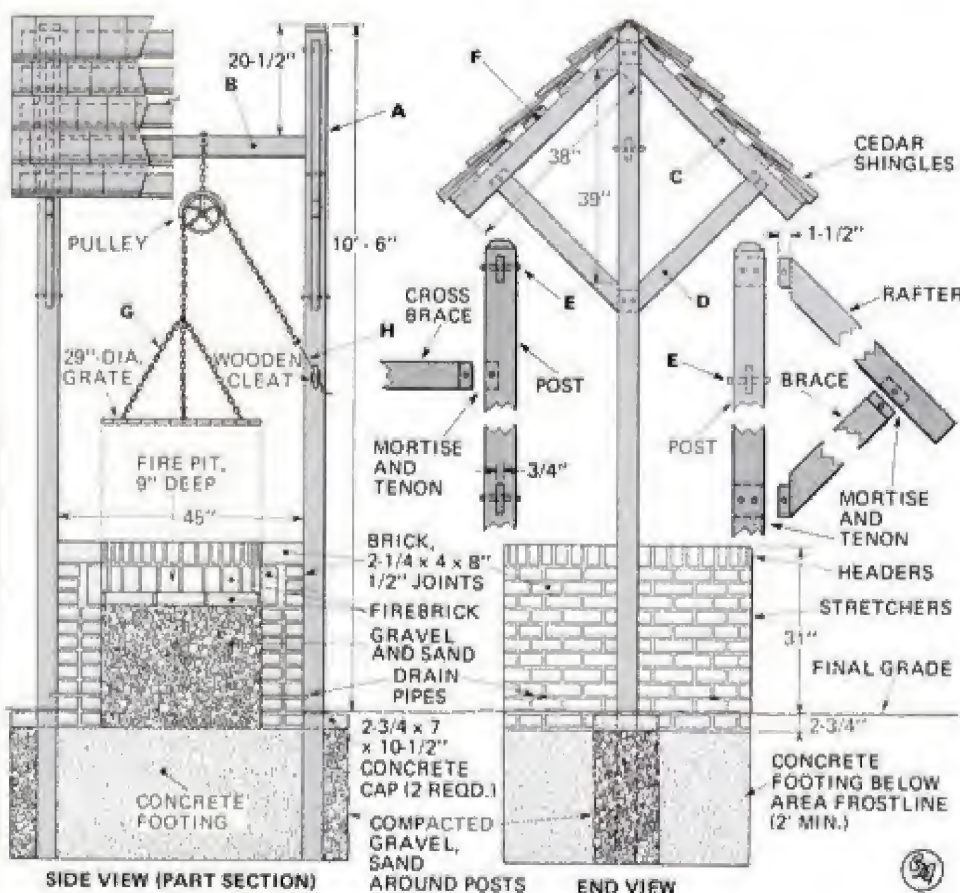
To form the circular brick wall, drive a 1/2-in. pipe into the ground at the center of the well (with a ring-type footing) or set it in the concrete (with a slab-type footing). Slip a small hose clamp over the pipe. Next, rip a narrow wooden strip 24 in. long. Bore a hole slightly larger than the pipe diameter at one end of the strip and fit it over the pipe. Then mark the outboard end of the stick at the well circumference and use it to lay each course of bricks accurately. The clamp, used as a stop for the pipe end of the strip, should be raised after laying each course.

Erect the roof and grill support. Then hang grill from a pulley, using four lengths of chain joined with an S-hook.—W.J. Edwards

MATERIALS LIST—BARBECUE

Key	Amt.	Size and description (use)
A	2	3 1/2" x 3 1/2" x 12' 6" pressure-treated wood (post)
B	1	1 1/2" x 3 1/2" x 48" fir (cross brace)
C	4	1 1/2" x 3 1/2" x 41 1/2" fir (rafters)
D	4	1 1/2" x 3 1/2" x 34 1/2" fir (diagonal braces)
E	14	1/2"-dia. x length-to-suit dowels (pins)
F	10	1/2" x 5 1/2" x 50" cedar (nailers)
G	1	1/2" x 11" galvanized chain, cut to suit
H	5'	1/4"-dia. sash cord
	340	2 1/4" x 4 x 8" (nominal) brick
	36	2 1/2" x 4 1/2" x 9" (nominal) firebrick
	22 cu. ft.	Concrete (or as reqd.)
	9 cu. ft.	Gravel and sand
	4 pcs.	1/2"-dia. x 9' drainpipe

Misc.: Wooden or brass cleat, bundle cedar shakes, well or other pulley, S-hooks, 26"-dia. grill (or to suit—ours was cut from expanded metal grate obtained from machine shop).





Bill C.
He's been a woodworker for years — for the fun of it. But his work is so professional he could sell everything he makes.



Jerry R.
He's your basic weekend "putterer". He's always got a project going to add value to his home.



Walt and Mary D.
They found that the only way they could afford to improve their home was to do it themselves.



Jack B.
He does it for fun like Bill C. But he sells his work at fairs and street markets — at fancy prices.

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No matter which do-it-yourself type you are, you've probably already learned one important fact. If you're going to do the job right, you need more than a couple of hand-held power tools.

You need things like a separate table saw, a vertical drill press, a lathe and more. And you need space — lots of space for the tools. And lots of money to afford them all.

But now you can enjoy a complete home workshop at a substantial savings — and in less space than a bicycle.

No matter what your level of woodworking skill and no matter how many power tools you now own, you owe it to yourself to find out more about the Shopsmith Mark V. Simply mail the coupon for the free facts about the 5-in-1 tool.

The Mark V actually gives you five of the most needed workshop tools — 10" table saw, 12" disc sander, horizontal boring machine, 16½" variable speed drill press, and 34" lathe — in one sturdy, free-standing unit ... that takes up less space than a bicycle.

Better savings ... better economy ... more versatility, too!

Because the Mark V has one rugged, precision-built, 13.5 amp., 110 volt motor to power all five tools, it actually costs less (and provides better quality) than the five single purpose tools it replaces.

And the Shopsmith Mark V is easy to change from one operation to another. After about an hour's practice, you'll be switching tool operations in less than 90 seconds.

What's more, you can actually accomplish

more with this amazing 5-in-1 tool because you can "borrow" features from one tool to increase the versatility of another.

The result is convenience and precision that you just can't get with your individual tools. So you'll find yourself sawing and sanding cabinets, beveling and mitering picture frames and windowsills, spindle turning and doweling to produce elegant tables, even metal drilling hinges, fence posts and more with a minimum of effort and cash outlay.

You'll enjoy tackling jobs you wouldn't even have considered before — actually cutting down your home maintenance bills as you add thousands of dollars to its value. And each job you tackle you'll end up doing right — thanks to the Mark V.



Mail the coupon for more free facts today! Find out why — even if you already have a workshop full of tools (and especially if you don't) the Mark V should be your choice.

One happy Mark V owner sold all \$12,000 worth of his commercial tools and replaced them with one Mark V. Why? Because, as he puts it, "I can do anything I was doing on all the machines and have a lot more room."

Don't you owe it to yourself to find out more about something so versatile, so high quality that it can replace \$12,000 worth of tools — and for less than 1/10 of the cost? You certainly do — especially when that information is free and without obligation.

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and out at speeds between 40 and 55 mph, and it does so with a perceptible surge. Some 6.1 percent of our respondents felt strongly enough about this to mention that it ought to be improved.

Other suggested changes included these: A glassblower from North Carolina: "I'd like the electric windows to have auxiliary handles so they could be operated manually with the key off."

A Wyoming rancher: "I don't like the aluminum hood and deck lid. They're too easy to dent."

A Michigan engineer and diesel owner: "They ought to make the starter interlock with the glowplug relay, so people who don't know it's a diesel can start it. There also ought to be a water separator or drain in the fuel tank." (Watery diesel fuel is a national problem, but aftermarket separators are available, and even GM offers one for about \$70 installed.)

Once again, our old bugaboo of quality control reared its head. These owners, while they liked the car, were irritated by the kind of minor problems that could have been corrected at the factory.

A Michigan auto parts counterperson states, "The trunk lid doesn't fit right. There's a big gap between the lid and the left fender, and a very small one between

the lid and right fender. It's not a big deal, but it just shows that nobody's looking at these cars when they roll off the line. Otherwise, the car is fine."

A Louisiana boat contractor: "I feel they ought to take a little more time to fit things together when assembling the automobile. Because of poor assembly inside the radiator, water leaked into my automatic transmission."

Comfort was judged *good to excellent* by 96.9 percent of front-seat riders and 95.8 percent of those in the rear. In this day of generally cramped rear compartments, that's a real tribute.

A Michigan manager told us, "Nothing



The huge, 21-cu.-ft. trunk makes this an ideal car to use for a long family vacation.

but good comments from all passengers—plenty of legroom, good ride, easy entry and exit from the rear seat. My father and I both owned 1978-79 Cadillacs, and we both bought 1980 Bonneville Broughams. We find our Pontiacs as satisfying to drive as the Cadillacs."

Specific complaints tended to be minor and half-hearted. An Ohio farmer, for example, grumbled that, "... when I spend \$10,000 for a car, it should at least have a normal spare tire, not that skinny thing."

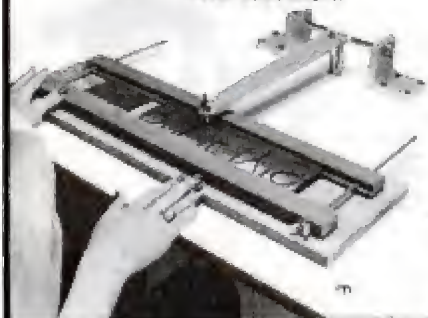
A Wisconsin shipping clerk: "How come they put such a small oil filter on the 301 V8? Do they want the engine to wear out faster?"

And a South Carolina sales manager: "The paint finish could be better. It seems awfully thin."

But, far and away, the majority expressed satisfaction with their cars. A Minnesota salesman and diesel owner told us, "On one recent trip of 468 miles, I used 12.7 gallons of No. 2 diesel fuel. That looks like 36.85 mpg—not bad at all. Please don't tell everyone that a diesel is the car!"

An Ohio surgeon: "Best *new* car I've ever had. Better gas mileage from my Bonneville with the 301 V8 than my 1980 Le Mans with V6. I find that the car has

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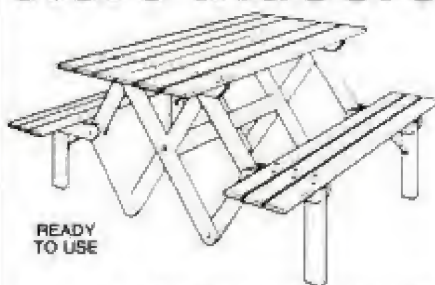
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outstanding ride and easy handling."

A Michigan sales rep: "I consider the exterior styling excellent and the interior design and materials likewise. I also appreciate the car's roominess and huge trunk. I feel it's a fine automobile."

Another salesman from Michigan says, "I do a lot of traveling in my job and I need to carry a lot of cargo. That enormous

trunk is the thing that sold me on the car. The mileage on a car this size is really good. I get 20 mpg."

An Indiana dentist had this to say: "I have a large family, so I was really forced into buying a big car. I was prepared to pay a mileage penalty, like 14 to 16 mpg. But I was surprised to get 19 to 21 with the Bonneville."

An Ohio utility risk manager: "Good ride and handling. Also, the V6 performs well in terms of power. This is my fifth Pontiac, and they've all been good."

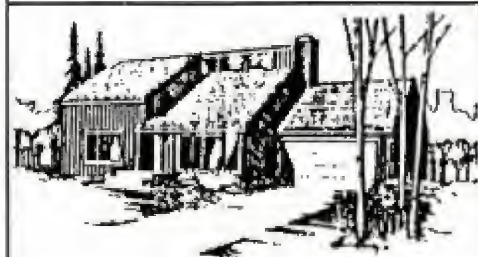
And finally, from a Florida home-products distributor: "I feel the Bonneville Brougham constitutes the best American luxury car you can buy for the money. I enjoy driving it." **PM**

SUMMARY OF 1980 PONTIAC BONNEVILLE OWNERS REPORTS*

Total miles driven 1,394,393	Economy 8.2	Comfort opinion (front seats):	Good 32.0
Average miles per gallon	Performance 7.0	Excellent 55.6%	Average 15.4
231-cu.-in. V6	Ride 7.0	Very good 30.9	Fair 7.1
In town 16.1	Specific likes:	Good 10.4	Poor 6.6
Long trips 19.9	Styling 42.9%	Fair 2.7	
265-cu.-in. V8 (too few to tabulate)	Handling 33.9	Poor 0.4	
301-cu.-in. V8	Comfort 33.9		
In town 15.3	Economy 29.2	Comfort opinion (rear seats):	
Long trips 19.9	Performance 15.0	Excellent 40.4%	
350-cu.-in. gasoline V8		Very good 34.5	
In town 15.6	Specific dislikes:	Good 20.9	
Long trips 20.0	No complaints 40.1%	Fair 3.8	
350-cu.-in. diesel V8	Disappointed in gas mileage 14.6	Poor 0.4	
In town 22.6	Poor paint and finish 7.5		
Long trips 28.6	Poor workmanship 7.1	Had any mechanical trouble?	
	Car noise and rattles 6.1	No 64.6%	
Engine choices:	What changes would you like?	Yes 35.4	
231-cu.-in. V6 7.8%	No changes 20.1%		
265-cu.-in. V8 2.9	Better fuel mileage 16.4	What type of trouble?	
301-cu.-in. V8 70.8	Better material 7.5	Carburetor 23.1%	
350-cu.-in. gasoline V8 9.1	Smother transmission lockup 6.1	Transmission lockup 17.6	
350-cu.-in. diesel V8 9.5	Better workmanship 6.1	Windshield wipers 7.7	
Model choices:	Workmanship opinion:	Speedometer cable 5.5	
Bonneville Brougham 52.2%	Excellent 26.5%	Electrical 5.5	
Bonneville 47.8	Good 47.7	Dealer repairs satisfactory?	
Why did you choose the Bonneville?	Average 13.8	Yes 65.9%	
Owned Pontiacs before 47.7%	Fair 5.4	No 34.1	
Styling 29.3	Poor 6.5	Dealer service opinion?	
		Excellent 39.0%	

*Percentages might not equal 100% due to rounding or insufficient data.

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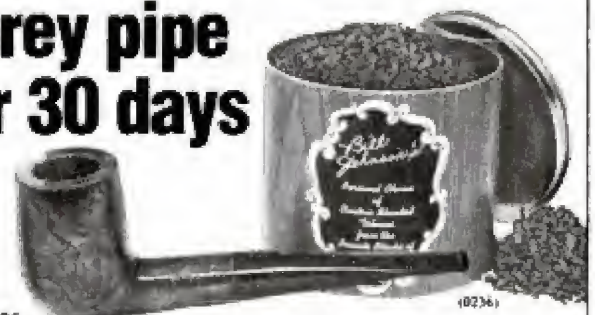
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A

A Both of these rules should be a boon to professional and amateur masons. The Mason's Modular Spacing Rule (No. 33-570) is designed for brick masons and tile setters using the modular system. It's marked with six scales in 16-in. modules, as well as $\frac{1}{8}$ - and $\frac{1}{16}$ -in. graduations. The modular scales include those for building blocks, facing tile, economy brick and small facing tile, engineered brick, standard brick and Roman brick. The Brick Mason's Spacing Rule (No. 33-575) is designed for gauging and maintaining even spacing of brick courses. It has 10 different brick-spacing scales, as well as $\frac{1}{8}$ - and $\frac{1}{16}$ -in. graduations for quick and easy reading. Both rules have $\frac{3}{4}$ -in.-wide by 10-ft.-long blades that are protected by Mylar film. They come with belt clips on their cases for handy carrying and they are priced at \$9 each. The rules are manufactured by Stanley Tools, Box 1800, Dept. PID, New Britain, Conn. 06050.

B



B This heavy-duty slide bolt helps keep mini-warehouses and other commercial and residential storage areas secure. The 11-ga., steel-center lock fits either the right or left side of a door. The zinc-plated shield is designed to protect a padlock from being cut. Yet for double protection, a second padlock can be secured on the unit, even when the shield is locked in place. The security slide bolt weighs about 1½ lbs. It is priced at \$7 and is manufactured by Holmes-Hally Industries, 7460 Bandini Blvd., Los Angeles, Calif. 90040.



C This resilient sheet flooring has a special moisture-barrier coat called Aquabar, which makes it particularly suitable for bathrooms, where condensation from the toilet tank and shower is a continuing problem. You can update your bathroom at minimal cost by installing this no-wax flooring yourself, following the manufacturer's directions. It's easy to maintain by cleaning periodically with a solution of vinegar and water. The pattern, called Haddonfield, has the look of ceramic tile. It comes in four colorations: white with beige tones; orange with beige; beige; and brown with light beige. Haddonfield is priced at about \$16 per square yard from Mannington Mills Inc., Box 30, Salem, N.J. 08079.

C



D Lexan polycarbonate resin replaces die-cast zinc and aluminum in the handle and flanges of this outdoor faucet (hose bibb). According to the General Electric Plastics Div., which makes Lexan, the material weathers as well as metal, yet is stronger and has greater impact resistance. The complete faucet is made by Woodford Manufacturing Co., Box 3369, Des Moines, Iowa 50316. It comes in various models for use on walls from 4- to 24-in. thick. The faucet is priced from \$10; with vacuum breaker it is priced from \$20.

D

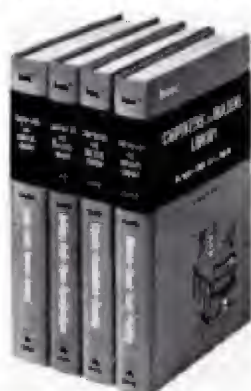




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**POWER FACTOR CONTROLLER CUTS
THE COST OF RUNNING ELECTRIC
APPLIANCES BY AS MUCH AS
50% -- AND YOU CAN EVEN SEE THE
SAVINGS!**

For over a year now, in magazines and newspapers the world over, there have been enthusiastic write-ups on a remarkable new device that can cut your electric bill while helping the U.S. save huge quantities of fuel.

"The NASA/Nola power saver," wrote a *Popular Science* senior editor, "was developed by Frank Nola at NASA's Flight Center in a program to reduce power consumption in spacecraft motors. Nola calls it a PFC — power-factor controller. I prefer to call it a power saver, however, because that's what it does."

NASA TESTED IT

According to NASA documents, "The device has been tested at Marshall Center on over 40 types of motors, with power savings ranging up to 60%, depending on the loading. The motors tested were both single-phase and three-phase, ranging from 1/2 H.P. to 5 H.P. Most motors will show up to 40 — 50% savings when running lightly loaded or unloaded, and some will show 5-to-7% savings at rated load."

NASA's Technical Support Package showed that "The Power Factor Controller applies to Induction type electric motors — the most commonly used type in all major home appliances and the most commonly used by industry."

HOW IT SAVES POWER

Popular Electronics explained it this way: "AC Induction motors characteristically run at a nearly constant speed that's fixed by power-line frequency and independent of load and supply voltage. When heavily loaded, the motor draws line current that is nearly in phase with the applied voltage...Under light load conditions, the motor develops less torque by allowing more lag between the voltage and the current. This reduces the power factor while leaving the current essentially the same in magnitude.

"To minimize this waste, Nola's device monitors the motor's power factor and when it detects light load conditions, it reduces the supply voltage..... The current, now more nearly in phase with the voltage, therefore does as much useful work as before, but it and the voltage are smaller, resulting in a net savings of electric power."

THE SAVINGS CAN ADD UP

The cost of electric power keeps going up. In 1980-81 and beyond you'll pay more and more for the privilege of running your electric appliances.

Right now, the typical consumer pays about \$8 per month to operate a 16.5 cu. ft. frost-free freezer...\$10 to run a 17.5 cu ft. frost-free refrigerator...and

about \$60 for an air conditioner used during summer months. That's what you're paying to run just one of these appliances per year.

Nola's power saver can soon pay for itself, then start reducing your electric bills. Until now, the device has not been available — except for industrial models priced at \$80 or more.

INTRODUCING THE WATT WIZARD

Cynex, an American manufacturer of electrical and electronic products and a prime contractor for the U.S. Army, has been licensed by NASA to manufacture Frank Nola's power saver. Cynex calls it the Watt Wizard.

The "Watt Wizard" says Ray Beauchea, the firm's Marketing Director, regulates the voltage fed into an induction motor making the motors run more efficiently and quieter, while lengthening motor life.



The Watt Wizard features a unique, constant power saving readout. So you can constantly monitor you're energy savings.

SIMPLE TO USE

Cynex makes several models of the Watt Wizard (all with solid state design), including the 110 v. AC plug-in model we're offering. It's for single phase fractional H.P. motors (less than 1 H.P.) used in most freezers, refrigerators, fans, swimming pool pumps, vacuum cleaners, sewing machines, etc.

Simply plug the Watt Wizard into any electrical outlet, then plug the appliance into the Watt Wizard. There's no wiring required. Unlike some competitor's models (if and when available), the appliance does not have to be turned on before being plugged into the power saver. You can leave the appliance — whether on or off — plugged into the Watt Wizard all the time. Or you can move the Watt Wizard to various locations.

OTHER MODELS AVAILABLE

Air conditioners, washers and dryers require wire-in model. If you lack mechanical skill, you probably need an electrician to install it. We also offer it in 220 VAC single or three-phase.



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Patent No. 4,052,648

EXCLUSIVE ADVANCE FEATURES

The Watt Wizard also includes two more unique features which no competitor has. It's fused so if you accidentally overload the device, it won't burn out. Just change the fuse, which is available at any auto supply store.

And Watt Wizard features a unique LED readout, so you can actually tell, at any moment, exactly how much power you're saving — 10%, 20%, 30%, 40% or 50%. This feature is available only on the Watt Wizard.

There's a "power-on" light, too. And the Watt Wizard comes with the manufacturers 1 year limited warranty.

LOW COST — AND A TAX CREDIT

We're offering the Watt Wizard for only \$39.95, with immediate delivery. Want two? Then its just \$37.95 each. Or splurge and get three at \$34.95 each. Wire-in models for heavy duty motors are \$6 more for each unit. Add just \$2.50 postage/handling for each order (not each unit).

And next year, when you fill out your tax return, you can deduct a full 15% energy tax credit — for additional savings.

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Try the Watt Wizard for up to 30 days. If not completely satisfied, return it (insured) for a full refund.

The sooner you send for the Watt Wizard, the more you can save on your electric bills. To order, send your check or money order to the address below. Or charge it to your Visa, MasterCard, American Express, or Carte Blanche credit card. If using your charge card, you can also order via our toll-free phone number:

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As one of the largest authorized mail order liquidators in the U.S., we frequently receive inventories that manufacturers must quickly sell at "sacrifice" prices.

There are many reasons for these closeouts, such as: Last year's models. Discontinued products. Bankruptcy or other serious financial problems. Overproduction. Plant closings. Rising production costs, etc., etc. If you know of any company in a situation that requires them to sell large inventories for quick cash, call us Toll-Free: 800-328-5082. Only products in perfect operating condition will be considered.

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A great bench model drill press with 5/8" chuck and Morse Taper. Ideal for the home handyman.

Here's a heavy-duty 14" drill press at a money saving, low liquidation price! The cost is even less than some of these little "sissy" models you see around town.

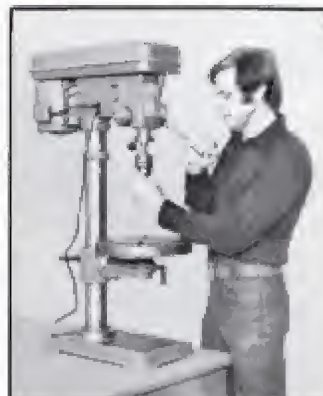
This 160 lb. "brute" has the power and the "guts" you need to drill through steel, cast iron, aluminum, brass, wood, plastic. Head and base are made of strong, fine-grained cast iron. Heavy walled machined column increases rigidity, cuts down vibration for smoother operation. Includes 3/4 hp. motor with standard NEMA 56 frame.

Oil table swings 360° and tilts 0° to 45°. Precise up and down movement of table with rack and pinion. Recessed socket in head lets you put in an electric light bulb for bright illumination of work. We priced these way down low to sell them FAST! Don't delay. Order yours right away.

- Capacitor start 110V motor; grounded receptacle; 10 amps.
- All belt pulleys on ball bearings; 5" largest pulley on spindle (high torque).
- Quick release belt tension.
- Chuck is 5/8" No. 3 J.T. Arbor
- 11" x 17" base; 2 3/8" column diameter.
- Height: 40 1/2". Weight: 160 lbs.
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- Spindle to base (max.): 23 1/2".
- 7" from spindle center to column.
- 1 1/4" diam. oil table with "T" grooves.

Fully enclosed belt guard case for safety!

Precision ground quill has milled rear rack



Recommended bit sizes to use:
In cast iron, 1/2". In steel, 3/8"
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scale both sides!

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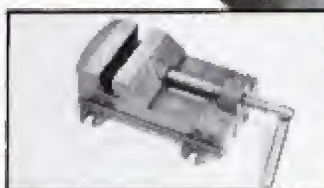
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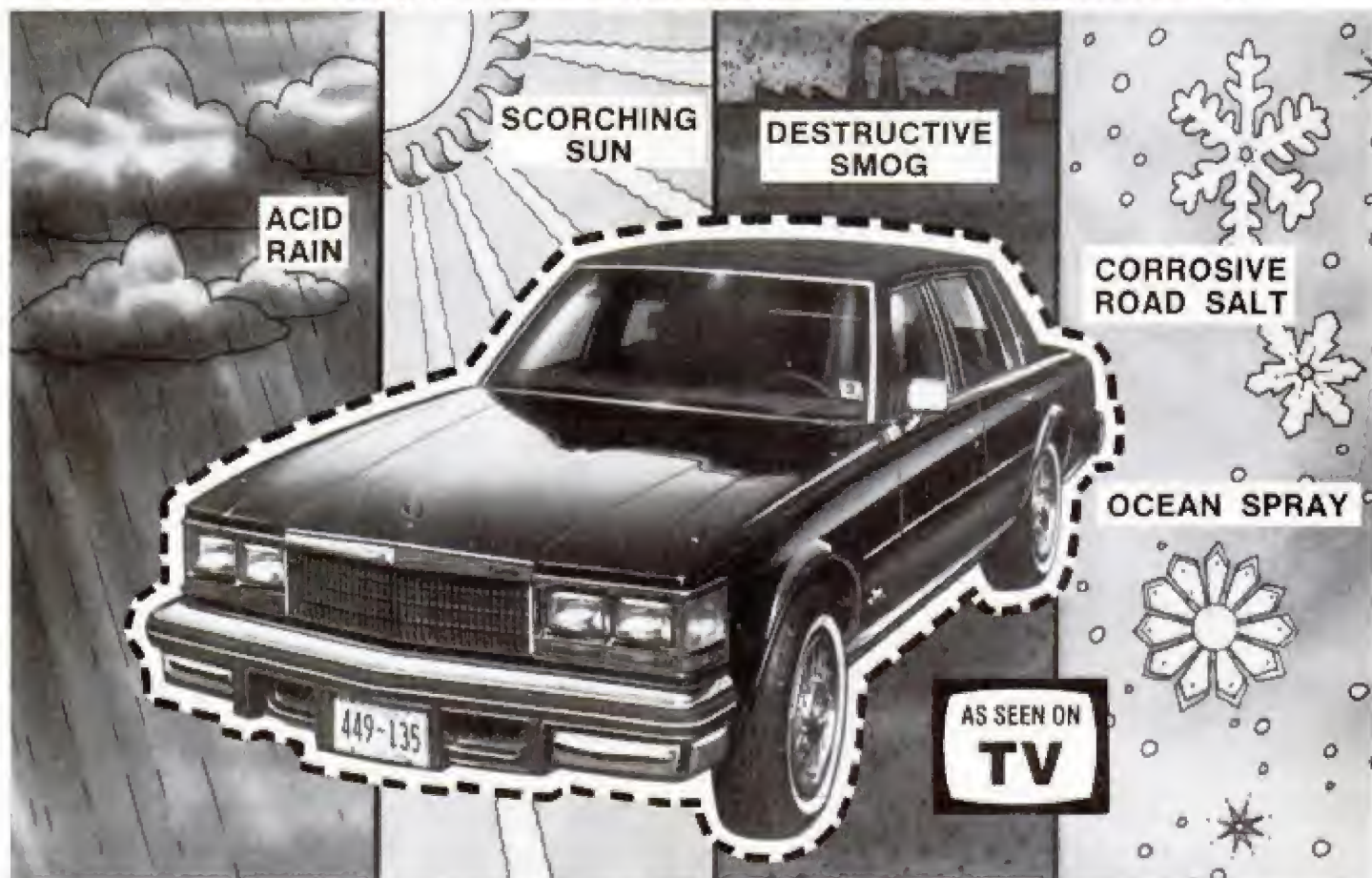
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5. Many car dealers offer to polymer seal your new car before delivery as an optional extra costing \$125-\$150 or more.

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Programmed for over a century

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The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

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10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off.

Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

The Power Source

Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

The most indestructible watch in the world
The workings of the watch: solar panels, energy cells, quartz crystal, computer on a chip, etc., are all permanently sealed in a Lexan module. This module is so unique it's protected by U.S. and foreign patents.

Completely waterproof

Leave the Sunwatch in salt water for months. Dive with it in depths up to 750 feet. There are no openings — magnetic slide bars activate all functions. With Sunwatch's exclusive, permanently sealed Lexan module, there are no "O" rings or seals to leak.



Shock resistant to 20,000 G's

You can crash it into a rug-surfaced brick wall at 80 mph with no noticeable effect. Wear it while doing heavy work, exercise or any strenuous activity.

Temperature resistant

Put the Sunwatch in boiling water for 30 minutes, freeze it in a block of ice for a year. Extreme temperatures will not damage your Sunwatch.

Pressure resistant

There are no air spaces inside the Sunwatch. Therefore, it is not susceptible to high pressures such as might be encountered diving to great depths.

The perfect watch for a lifetime

Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

Made in the United States

The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

* A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

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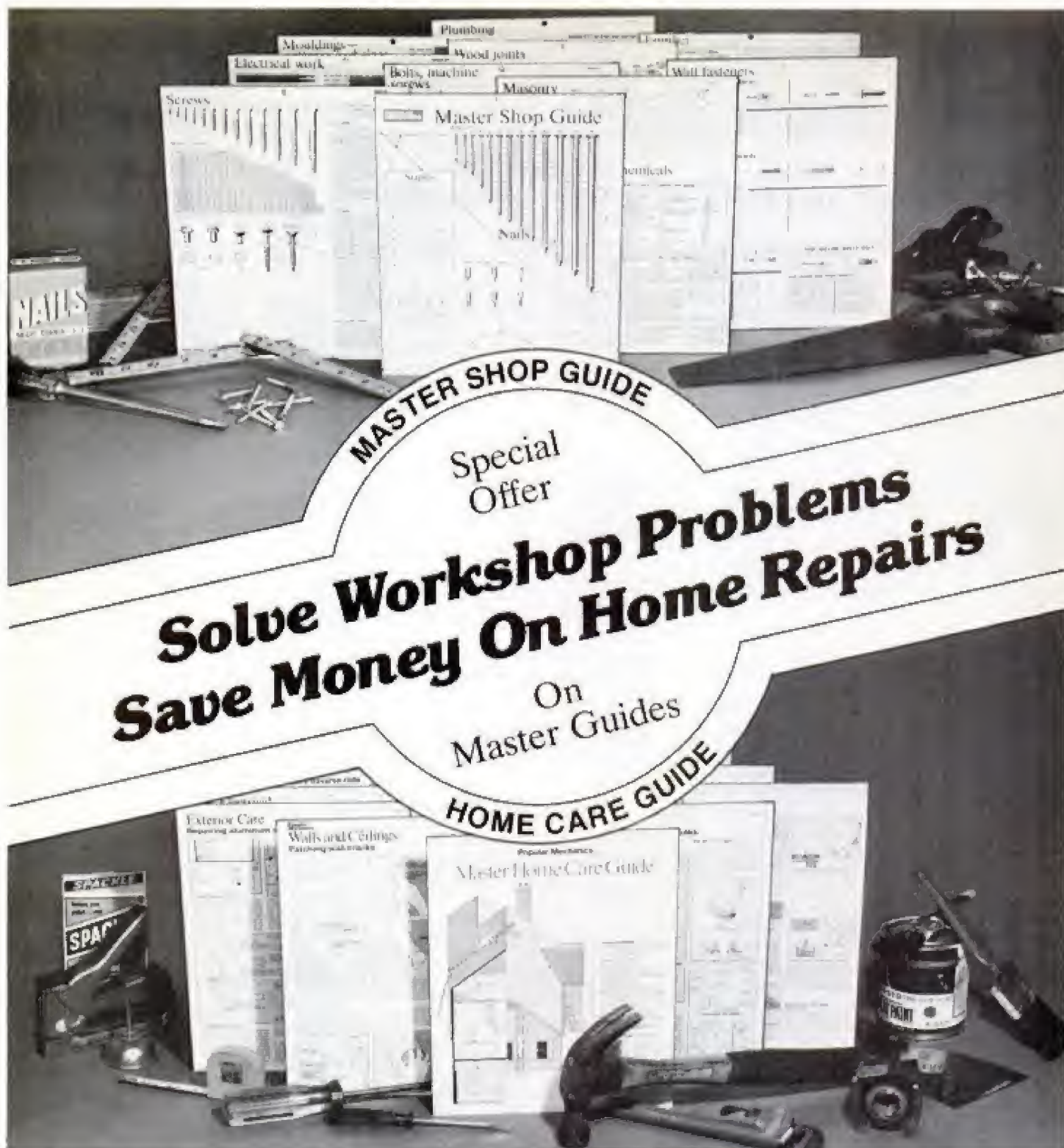
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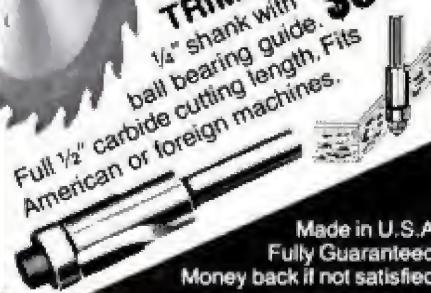
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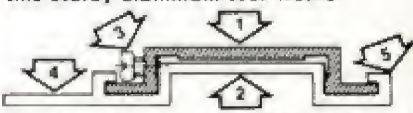
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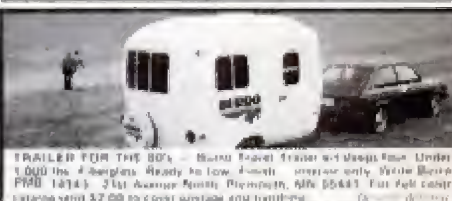
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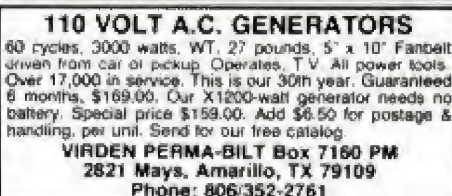
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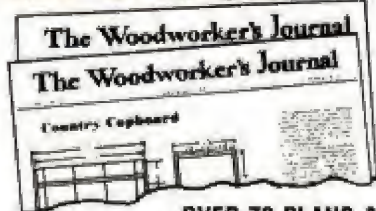
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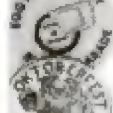
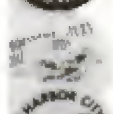


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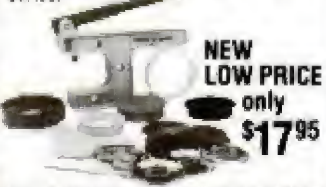
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